THE

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"ELECTRICAL REVIEW."

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THE

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MR. CHAMBERLAIN'S SCHEME.

No one but a party politician is justified in saying that a political pronouncement of great import to the nation, formulated by responsible leaders, is put forward with the object of catching votes at a forthcoming election, and no one should be permitted to say that the fiscal policy of this country should necessarily continue upon lines laid down half a century ago. The pronouncements of a politician must be considered on their merits, and in these progressive days even the policy of a nation must change if change is clearly shown to be desirable.

Mr. Chamberlain has brought into the forefront the question of Protection, not, indeed, upon its merits, but as a subject for inquiry. He seeks a mandate not to carry any plan into execution, but to devise a plan.

> Now, in that event, when we have got a mandate, which we have yet to get, then will be the time to produce a plan. A plan in the sense of a definite complete scheme is absolutely impossible until we know a great deal into which we have still to inquire, and into which we cannot inquire profitably and advantageously unless we know we have the country behind us. Is that not common sense?

To a somewhat similar question, though not propounded by the Autocrat of the House, the Autocrat of the Breakfast Table once replied, "Precisely so, my dear sir . . . common sense *as you understand it*."

Removed as we are from influences of party politics, admiring as we do Mr. Chamberlain's strong personality, and appreciating as we do, much of his able work, we are obliged to say that the common-sense view, as he understands it, is rather the view of the politician seeking votes than that of the statesman seeking the welfare of his country; for he demands a mandate of inquiry on vague suggestions that Imperial unity, individual and general prosperity will be promoted by the introduction of protective duties, which, in addition to supporting the worker in greater luxury, will provide a surplus fund from which the State will be able to assist his declining years with a suitable pension. The common-sense of the statesman would, we think, suggest that it is for him to satisfy himself by inquiry that a certain line of policy is practicable and desirable for the State, and then to submit it to the electors for their approval. In every detail, no; in broad outline, yes.

It is assumed in some quarters that the free trade sentiment in this country is so strong that Mr. Chamberlain's demand will be met with a prompt refusal, but of this we are by no means satisfied. Considerable allowance must be made for the galling effect upon our manufacturers and traders of the number of doors closed to them, and the wide-openness of our own door to foreign manufactures which they are, or believe themselves to be, well able to provide. To such Mr. Chamberlain's suggestion will be regarded as of definite purport and of much promise.

Their number is large. A yet larger number have no definite views, but will see no harm in inquiry. Thus Mr. Chamberlain's net is of such a mesh and so far spread as to secure fish of differing types, and the obtaining of the mandate is, to our minds, by no means an impossible event. If obtained, it will not be possible for the inquiry to be entirely fruitless.

Some action will have to be taken in the direction indicated. It may be minimised, but not entirely prevented, for no one starts on an inquiry with pre-conceived views without finding his views to some extent supported by the results of such inquiry. We trust, therefore, that inquiry may precede the mandate, and not the mandate precede the inquiry. If the inquiry shows that our Free Trade policy is old-fashioned and out-of-date, by all means let us modify it; but let us also bear in mind the possibility that Free Trade may be shown to be not less necessary but more necessary to us now than it was in the time of Cobden.

Although brought thus suddenly before the country, it must be remembered that the idea of a Customs Union is not new to Mr. Chamberlain. Since first he dallied with it he has had ample time to consider how far it may be practicable and what would be its probable effects. We do not doubt it will be urged that he has considered it, and that the fact of his dealing with it as he does now is proof that he considers it practicable. If such be the case we have confidence in Mr. Chamberlain's ability to demonstrate to others what is clear to himself, so that a clean-cut issue might be submitted to the electorate, and they might be saved that disaster or disappointment, as the case may be, which must result from a mandate of inquiry in the form suggested.

The task which Mr. Chamberlain sets himself is to demonstrate that some means may be found to compensate us for obtaining our supplies from other than the natural sources. We are not dependent on Seville for our oranges—we can produce them at Kew. It is only a question of sufficient protection and a compensation for the cost. The inquiry may demonstrate that we can obtain our corn from more northern latitudes at a greater cost than now, and still be able to profit; but let it first be demonstrated before we talk of action.

And if protection offers no advantage in itself, it is futile to utilise it as Mr. Chamberlain proposes for the purpose of negotiation. There can be no better specimen of that unsatisfactory operation expressed by the homely adage which tells of cutting off one's nose to spite one's face.

But perhaps the most surprising feature in Mr. Chamberlain's surprising speech is that in which he raises the bogey of our ruined industries and our markets flooded with the products of our protectionist competitors when their home markets experience a slump. Let us by all means recognise the possibility, but let us also not meet trouble half way by assuming that no compensating circumstances will be found. No "bankrupt stock" is put upon the market at an "alarming sacrifice" without a disturbance to the business of manufacturers in a similar line, but the manufacturers do not necessarily go out of business. And though it is unfortunate that anyone should be bankrupt, the chance of a cheap purchase to somebody prevents the loss being entirely without its compensation to the community. In our judgment we English people are far too prone to see our disadvantages and not sufficiently ready to recognise the disadvantages of other peoples. Let us for one moment consider this overproduction keep-the-works-going bogey in the enterprise with which we are directly concerned.

It is not very long ago that electrical people here were telling us that our banking methods were old-fashioned and out of date. Our electrical industries needed the stimulus of enterprise such as German banking systems provided. Is there to-day any desire for the electrical industries of this country to change places with those of Germany? Is there to-day any strong wish on the part of the average bank shareholder to suggest that there would be any advantage in our banking system being assimilated to that of the industrial banks of Germany? And so far from our markets being flooded with the products of the stimulated works, is it not rather the fact that, after the usual and temporary "bankrupt stock" experience, our own works are busy and the German works stagnant? We believe that it will be time enough for us to take measures to protect ourselves from the "surplus product" phantom when we are seriously suffering from it. "Keeping the works going" is all very well; but let us remember that keeping the works going in dull times is not exactly the same thing in a protectionist country that it is with us.

Mr. Chamberlain seeks information from trade centres and from Chambers of Commerce as to "what particular article or articles of manufactured produce in their districts could be much more largely sold if preferential rates were given to the colonies upon it or them, and what the amount of that preferential rate ought to be to give them any substantial advantage." What a formidable list such an inquiry might be expected to call forth! Who is there that would not wish his particular manufacture to be protected? No industry of the United Kingdom is a thing apart; each is dependent upon the general prosperity of the country, and so far as the electrical industry is concerned, we see no reason at present to amend our view that it needs neither the stimulant of the German Industrial Bank system nor the sedative of Protection.

Radiation from the Human Body.

Every day we are hearing of additions to the number of radio-active bodies. The tips of lightning rods, the leaves of trees, and, indeed, the whole surface of the earth have been shown to be continually emitting some kind of Becquerel radiation. And now, if we are to believe a rather sensational account from New York, the human body has been shown to emit some kind of radiation capable of making an impression on a photographic plate. Prof. Goodspeed, of the Morgan Laboratory of Physics in the University of Pennsylvania, has, according to the accounts in the daily papers, communicated to the American Philosophical Society his discovery that rays emanating from the human body possess photographic potency. Photographic specimens were exhibited in illustration of the Professor's theory. The human rays, it appears, pass with difficulty through glass, but easily through aluminium. The rays, according to this account, are of low penetrative power, and therefore are most likely positive electrons. Until we hear more about the experiments, it would be rash to speculate as to the cause of this radiation. There is no evidence that the human body has any permanent electrical charge other than that which it

shares as part of the earth's surface. This, indeed, may be the origin of the Goodspeed radiation, but if so, the radiation will not be peculiar to the human body, but will be common to all bodies on the earth's surface.

Coherer Action Under the Microscope.

THERE has been much discussion as to the real nature of the action of the coherer, and evidently a good deal of light might be thrown on this question by examining the filings under the microscope. This experiment has been carried out by G. T. Hanchett, who describes his results in the *Electrical Review*, New York. A slide was prepared with two wires, the wires being attached to the slide with shellac and bound with pieces of glass. The wires should be brought within $\frac{1}{32}$ of an inch of each other, and one should be led off to the ground, while the other may lie freely on a table or be connected to a mast. Electrical waves are excited in another mast by an induction coil. Having focussed the microscope on the gap between the wires, it will be observed on operating the induction coil that a stream of sparks passes from terminal to terminal on the microscope stage, and appears quite formidable when viewed through the instrument. A pinch of nickel filings may then be sprinkled between the terminals by means of the point of a knife, and their action on operating the coil will be unmistakeable. The filings are seen to rearrange themselves with a mechanical movement, and sparks scintillate among them. After the passage of a few sparks at the coil the sparks on the microscope slide, and the motions of the particles, will cease. Mr. Hanchett comes to the conclusion that the action of the coherer is entirely due to rearrangement of the filings under the action of electrostatic forces, the resistance being reduced by the particles being pressed closer together. But how does this theory explain the action of such substances as potassium, whose resistance *increases* under the action of electric waves? Mr. Hanchett should examine the action of some of these anomalous substances under the microscope. The experiments of Dr. Chunder Bose (see ELECTRICAL REVIEW, Vol. 47, p. 449) point to quite a different theory of the coherer.

A Shock of 5,500 volts.

IN the *Neues Wiener Tagblatt*, of March 20th, an extraordinary case was described in which a workman was subjected to a discharge from a 5,500-volt three-phase circuit for the space of five minutes and yet survived. He appears to have suffered no permanent injury except to his hands, which were so severely burnt that it was considered that amputation might be necessary. The upper skin of the front and back of the hand, and of the left forearm, was entirely detached from the lower skin, and was completely charred and dried up. The under skin looked as if it were cooked, and had lost all sensation. The sole of the left shoe was perforated and torn away in places. The unfortunate man was suspended for five minutes from the live wire, and bystanders assert that flames were seen proceeding from his hands and feet. Dr. Jellinek, who delivered a lecture on this case to an Austrian medical society, came to the conclusion that 10 to 12 H.P. raged for five minutes in the body of the unfortunate workman, but, in making this calculation, it is doubtful whether he made sufficient allowance for the very high resistance of the charred skin and the leather soles of the boots. It is, however, a remarkable fact, that a human being should suffer such a shock under the most favourable conditions and still survive.

STASSANO ELECTRIC FURNACE STEEL PROCESS.

IN a paper recently read before the Cologne Electro-chemical Society by Dr. Goldschmidt, some interesting particulars are given about the production of iron and steel in the Stassano electric furnace. It appears that the inventor has devoted a great deal of personal attention to his method, and has watched and conducted his own process in every detail, and so deserves great praise for his excessive zeal.

The current used in the experiments, which are being carried out at the experimental works at Darfa in Italy, is an alternating one, and is supplied by two large dynamos of 500 H.P. each and one smaller one of 100 H.P., all driven by water power.

The essential feature of the process consists in the direct reduction of the iron ores by charcoal or coke, the heat being supplied by a powerful electric arc working above the charge. Suitable fluxes are used to flux off the undesirable compounds in the ore.

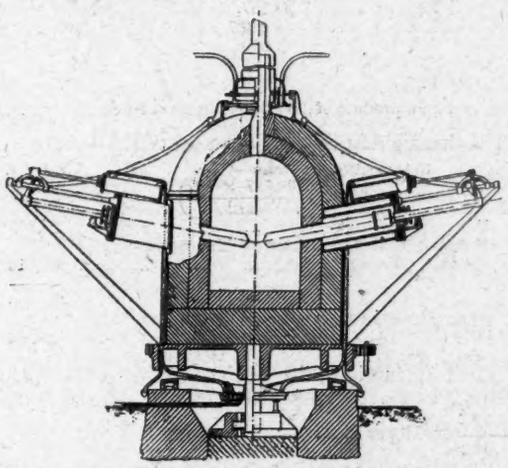


FIG. 1.

The latest form of Stassano furnace is shown in the accompanying illustrations. Fig. 1 is a section through the plane of the electrodes, and fig. 2 a section at right angles to fig. 1. Arrangements are provided for drawing the electrodes apart during the reduction, and also for revolving the furnace round its vertical axis.

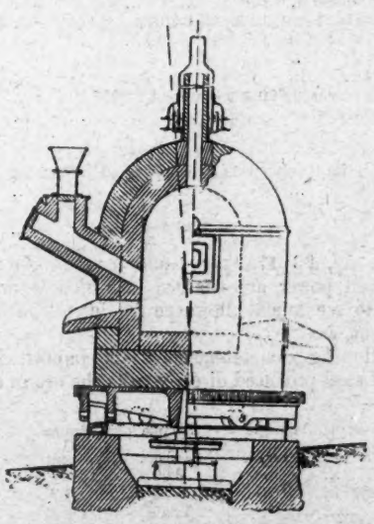


FIG. 2.

The furnace, which is constructed of masonry, has a working chamber of 1 metre diameter and 1 metre in height. At the beginning of the operation the electrodes are near together, but as the temperature rises they are separated until the arc extends across the entire width of the furnace producing a great noise. The current is then regulated in

such a way that after 20 minutes the voltage is 80 and the current 800 amperes; after a further 20 minutes, volts = 100, amperes = 1,000; after another 30 minutes, volts = 70, amperes = 600; after another 30 minutes, volts = 50, amperes = 500. The reduction thus occupies two hours from commencing to casting, the first hour being occupied in introducing the charge.

The author gives complete analyses of different Italian ores, magnetite, red hæmatite and limonite, which all show a somewhat remarkable degree of purity, and this fact would be in favour of any process for its reduction, whether electric or otherwire, and may account to some extent for the purity of the iron produced.

The following represents a charge run through in a furnace (with volts = 80 and amperes = 1,000). The charge mixture was made up as follows:—Iron ore 1,000 parts, limestone 125 parts, carbon 160, and "additions" (hydrocarbons, etc.), 120, and weighed in all 70·25 kgs.

The following table shows the amounts of reducable substances in the charge and the amount actually reduced (in grammes).

Substances.	Charged (grms.).	Obtained (grms.).
Fe.	32,557	30,727
Mn.	239·7	28·3
Si.	910	traces
S.	29	15
P.	28	2·7

Showing a product of 30·8 kilogrammes of wrought iron.

The thermic relations may be stated thus:—

Heat required as follows:—	Calories.
For reduction of iron $\left(\frac{30{,}727 \times 192}{112}\right)$	52,730
For melting metal	10,780
For melting slag, reduction of Mn, evaporation of water, burning lime, &c.	10,510
	75,020
Heat generated by combustion of C to CO ...	21,495
Difference	53,524

The heat furnished by the electric current was 84,012 calories, so that the thermal efficiency may be taken as $\frac{53{,}524}{84{,}012}$ or 61 per cent.

The following is the calculated cost for 1,000 kg. of iron in a plant of 5,000 H.P. producing 30 tons of steel in 24 hours (taken at about 66 per cent. thermal efficiency).

	Lire.
1,600 kg. ore at 15 lire	24·00
Pulverisation of ore	4·80
200 kg. flux at 5 lire	1·00
250 kg. coke at 45 lire	11·25
Pulverisation of coke	0·50
190 kg. "additions" at 70 lire	13·30
Making mixtures, 3 lire	6·75
Wear of electrodes, 12 kg. at 0·30 lira	3·60
Maintenance of the furnace	12·00
Wages	6·00
Utensils	3·00
Electric power, 4,000 H.P.-hours at 0·0057 lira ...	22·80
Incidental costs	3·00
Total	112·00
Less volatile combustible gases obtained, 900 cubic metres	18·00
Actual cost...	94·00

This is, say, £3 17s. per 1,000 kg., but the incidental expenses and power are charged at rather a low rate, and one fails to see much allowance for interest, depreciation, management, &c.

The following is a statement of the impurities in three samples of steel produced directly from the ore in a Stassano furnace:—

	Sample I. Per cent.	Sample II. Per cent.	Sample III. Per cent.	Chromium steel. Per cent.
Carbon ...	0·04	0·09	0·17	1·51
Manganese ...	0·05	0·18	0·07	0·26
Silicon ...	—	Trace	Trace	—
Sulphur ...	—	—	0·05	—
Phosphorus	—	—	0·029	—
Chromium ...	—	—	—	1·22

All these calculations are evidently based upon the local conditions prevailing where the experiments are being carried out, a locality in which one would suppose they were rather favourable to such a process, but all these figures would obviously be modified somewhat in a coal-bearing country where water power was not available. In such a district it would resolve itself simply into the comparative efficiencies of the direct and indirect methods of using the available heat in the coal.

PARLIAMENTARY.

Exeter Tramways.

Lord Glenesk's Select Committee of the House of Lords considered this Bill last week.

The promoters are the Corporation of Exeter, who were represented by Mr. Balfour Browne, K.C., Mr. Hutchinson and Mr. Thomas. The Bill was opposed by the Great Western Railway and also by a few residents on the route of the proposed tramways.

Mr. Balfour Browne opened the case for the promoters. He explained that the Bill was to empower the Corporation of Exeter to construct tramways, execute street improvements and for other purposes. It was proposed to re-construct certain existing tramways and to construct additional lines. The whole system would then be run by electric traction or other mechanical means. The city was at present inadequately served by horse trams, which did not serve the railway stations. Some time ago the company who owned the trams stopped running over half the lines. The gradients in places were very heavy, and horse mortality had been very great. For some time the City Council had been thinking of the advisability of creating an effective system. Companies had approached them asking to run tramways, and one company had promoted a Bill, which fell through, however. At length a deputation of the Council made a tour through certain towns to see the methods of working, and they reported in favour of the overhead trolley system. Then they consulted Mr. Waller, of Messrs. Kincaid, Waller & Co., and their own surveyor proceeded to lay out a scheme of tramways. A poll of the town was taken, and resulted in a majority of nearly 3,000 in favour of the trams. The opposition was mainly from people in the High Street, but even there a majority of the tradesmen were in favour of the trams. The Corporation held the view that the business centre of the city must be served, then the railway stations and the factories, workshops, &c., and lastly, the population in the outskirts of the city. The lines were intended to serve districts at a considerable distance, some as far as two miles from the centre of the city. The length of the lines, however, was only 7¼ miles. The estimate for the whole of the work, including £15,000 for street widening, was £120,000. It was a fact that High Street was narrow and certain irregularities in the buildings would have to be rectified. It was proposed to make improvements at three points. In High Street and elsewhere it would be arranged to have sufficient room on either side of the rails for a vehicle of full size to stand.

Mr. George R. Shorto, the town clerk of Exeter, gave details as to the difficulty of getting to the various railway stations. He said that in 30 years the number of inhabitants in Exeter had increased 32 per cent. The tendency nowadays was for people to reside somewhere beyond the boundaries of the city, and that necessitated good communication. Cross-examined by Mr. Talbot (for some of the residents on the route) witness said that the High Street was the only way through the city. The Corporation were owners of plant, and could supply the electric power themselves.

Witness gave details of various undertakings which the Corporation had taken in hand and which he said had paid well.

Mr. Edwin Charles Perry, chairman of the Tramways Committee, was then called, and gave evidence as to the inadequate service now in existence. It was absolutely essential that the tramways should go down the High Street.

Mr. Moulding, the City engineer and surveyor, said he considered the streets suitable for tramcar traffic. For the construction and equipment of the tramways, including the provision of land, carsheds, and rolling-stock, he estimated the net cost at £77,000 and road widenings would take £15,000. For a distance of 600 yards from Fore Street to High Street it would be impossible to provide 9 ft. 6 in. between the tramway line and the kerb, and that condition applied to one or two other small sections. He had calculated the working expenses at 6d. per car-mile and the receipts at 9d. per car-mile. The total car-mileage was estimated at 593,000 per annum—they estimated that they would carry the entire population 80 times during the year.

Mr. Waller, M.I.C.E., gave evidence as to the engineering part of the scheme, and said there was nothing in the scheme dangerous or inconvenient to the public. He corroborated the previous witness as to the cost of construction. Tramways were, he thought, very badly needed in Exeter, and would, he believed, pay well. There was really nothing in the width of the streets, for even the Postmaster-General had raised no objection on that score, and if there would be room enough for a Post Office van to stand in the road there would be plenty of room for any other vehicle. This concluded the evidence for the Bill.

A number of witnesses were then called in opposition to the scheme, the chief objection being that the roads were too narrow, and that a tramway would seriously interfere with the ordinary vehicular traffic.

After hearing Mr. Talbot for the opposition and Mr. Balfour Browne for the promoters, the Chairman announced that the Committee found the preamble of the Bill proved.

South Shields Corporation Bill.

A Select Committee of the House of Commons, presided over by Col. Bowles, sat for several days last week to consider a Bill promoted by the South Shields Corporation, the main provisions of which relate to the construction of electric tramways by them. The British Electric Traction Co., who are promoting a Bill for the construction of tramways from Sunderland to South Shields, appeared in opposition to the Bill. Mr. Pember, K.C., appeared for the Corporation, and Mr. Freeman, K.C., represented the Traction Co.

In opening the case for the promoters, Mr. Pember explained that last year the Corporation promoted a Bill to obtain powers to alter the gauge of their existing tramways, to obtain full powers of working, to adapt them to electricity, and to make certain extensions. That Bill was rejected by the ratepayers at a borough funds' meeting, and consequently it was abandoned. The present Bill, which was very similar to the one proposed last year, had received the approval of the ratepayers, who were satisfied that the Corporation did not wish to work the tramways at any cost, but that they were honestly desirous of leasing them if they could obtain reasonable terms. With regard to the position of the British Electric Traction Co., the Corporation objected to anyone else making tramways in the borough—they claimed to be masters in their own house.

Mr. Freeman said that as he understood Mr. Pember, he claimed that the Corporation was the best body to carry out tramway schemes within the borough. He admitted that there was a good deal to be said for that proposition, and if matters could be arranged on reasonable terms, his clients did not wish to interfere with the carrying out of municipal duties. The British Electric Traction Co. attached great importance to the piece of their proposed line which was within the borough of South Shields. If they obtained control of that line, they would not only link up Sunderland with South Shields, but also with towns beyond. They were the owners of the authorised Jarrow Road tramways, and they also had a considerable interest in the South Shields tube, which was at the further end of the borough. It was, therefore, essential, if they were to obtain a through route, that they should be able to get through South Shields. They did not object to the Corporation constructing the tramway, if the Traction Co. were put in a reasonable position to use them. His suggestion was that the Corporation should make the tramway in Westoe Road, which formed part of the proposed through route, but that they should undertake to make it of such a gauge that it could be worked in conjunction with the trams of the Traction Co.

Mr. Pember said the position of the Corporation was that they did not want to work the tramways if they could lease them on reasonable terms, and the company were willing that an independent tribunal should settle the terms on which a lease should be granted.

Alderman J. R. Lawson, chairman of the Parliamentary Committee of the South Shields Corporation, replying to counsel, explained that the present Bill was a more moderate one than that of last session. Then they proposed to construct 10½ miles of tramways at a cost of £264,000, whereas, in the present Bill, only 8 miles of tramways were proposed, and the estimate was reduced to £175,000.

Mr. Cawthra, electrical engineer to the Corporation, explained the proposed extension of the Corporation's electricity supply undertaking. He said that the new plant would supply continuous current, but it was proposed to continue the use of the alternating current for lighting purposes. Cross-examined by Mr. Dickinson, the witness said it was true that the Corporation had offered people free electric light, as an advertisement, for three months in the summer.

Mr. Alderman Reynoldson gave evidence relative to the working of the electricity undertaking of the Corporation. He said they now had 906 consumers with 47,674 8-c.p. lamps. In the last 4½ years there had been a charge of £5,114 upon the rates, but in all probability the undertaking would make a contribution to the rates this half-year. The supply of energy to the tramways as proposed would help forward the electricity undertaking. With regard to the Corporation offering ratepayers free current last summer, it was done on the principal of throwing a sprat to catch a mackerel; and while he held that it was a fair commercial advertisement, he did not think the experiment would be repeated. On the question of the tramways, witness was of opinion that, while it was desirable that there should be through communication between South Shields and the rural districts surrounding it, it could be given by a change of cars at the borough boundary. In cross-examination, witness said he was in favour of intercommunication on fair terms. To get proper terms for leasing, the Corporation must have the power to work the tramways themselves. He had no objection to the British Electric Traction Co. being granted a lease, if they were prepared to offer the Corporation fair terms. So far none of their proposals had been acceptable by the Corporation.

Mr. G. B. Hamilton, general manager of the Leeds City Tramways, and Mr. Le Rossignol, the general manager of the Newcastle Tramways, gave evidence in support of the Bill.

Mr. J. M. Hatton, the town clerk of South Shields, said that clause 15 of the Bill gave the Corporation power to work the tramways and repealed Sec. 22 of the Act of 1896, which compelled them to lease them. Neither the Corporation or the ratepayers desired that the old restrictive clauses should remain in operation. Replying to Mr. Freeman, the Witness said he could not say what were the actual intentions of the Corporation as to working or leasing—as no resolution had been passed pledging them either way. The Corporation wished to be their own judges as to what they considered reasonable terms for leasing. This concluded the case for the Bill.

Evidence was then called in opposition to the scheme on behalf of the Local Gas Co.

It was then agreed to at once proceed with the British Electric Traction Co.'s scheme—the South Shields, Sunderland and District Tramways Bill—Mr. Freeman, K.C., who appeared for the Traction Co., dispensing with a speech in opening.

Mr. Stephen Sellon, the chief engineer to the Traction Co., said that company had a capital of £7,000,000. They had already constructed and were working 400 miles of tramways and light railways, while another 225 miles of authorised tramways were now in course of construction. The tramways worked by the company carried 400 million passengers per year. In the Bill now under consideration they sought powers to construct 6½ miles of tramway. The line would start from the boundary of Sunderland, and pass through Whitburn, Cleadon, and Harton to South Shields, terminating in Fowler Street opposite the terminus of the tube railway. The estimated cost of construction was £58,786. There was no doubt that the line would be very largely used by passengers, and people living in the district were very anxious to get increased facilities for the carriage of goods. The company proposed to give those facilities by establishing depôts at various centres along the line. Vans would be attached to some of the cars, and goods would be distributed from the various depôts. It was absolutely essential that they should have a through route in South Shields. Without such an arrangement they would not be able to carry out the other portion of the line successfully. If the Corporation constructed the lines in South Shields the company would be perfectly willing to take a lease of them on fair and reasonable terms. They were perfectly willing to let the Board of Trade or some other independent tribunal to be named by the Committee settle the terms between the Corporation and the company. It was very necessary that some such arrangement should be made, because if not, the inhabitants of South Shields must be without tramway communication for some years, owing to the fact that the lease of the existing lines would not expire for another 2½ years.

A number of local witnesses were then called to speak of the need of further means of transit over the proposed route.

Colonel Yorke, Board of Trade inspector, was called at the instance of the Committee with reference to the practice adopted by the Board of Trade with regard to tramways in narrow streets. He stated that one proposed tramway of the Corporation would only leave 9 in. between the side of the car and the kerb, whereas it was desirable to have a width of 18 in.

It was agreed that a clause should be brought up which would prohibit the Corporation constructing a double line at this point without the consent of the Board of Trade.

After further local evidence had been given, a consultation took place between the parties; and Mr. Pember, K.C., stated that the British Electric Traction Co. were prepared to allow the Corporation to take their Bill, and the company would abandon their application for a line along Sunderland Road and Westoe Lane.

Mr. Freeman, K.C., remarked that his clients had talked the matter over with the South Shields representatives, and it was thought that there were reasonable grounds for thinking that arrangements would be made for an effective through service.

The Chairman wished to know the reason for this change of opinion.

Mr. S. Sellon said that up to now, although they had had many meetings, the parties had not come to a friendly discussion. He believed now that, if they got the powers they asked for, South Shields would support them as they were anxious to get to Harton and other places, and therefore they saw the necessity of entering into some arrangement with the company for through running.

Mr. E. Moon, K.C., who appeared for the North-Eastern Railway Co., addressed the Committee in opposition to the British Electric Traction scheme. He contended that his clients would be seriously affected by the competition, and it had not been shown that the railway was not doing its duty.

The Chairman said the Committee found the preamble of the South Shields Corporation Bill proved, but the clause giving them power to supply electrical apparatus would have to be struck out. Further, a clause must be inserted providing that the treasurer of the Corporation should each year after the first year's working lay before the Corporation a statement and balance-sheet of the tramways accounts, and that the tolls, fares and charges to be levied for the ensuing year should be fixed so that the revenue met the expenses shown in the balance-sheet. They found the preamble of the South Shields, Sunderland, and District Tramways Bill not proved.

New Group.—A Select Committee of the House of Lords, under the chairmanship of Earl Lytton, will on June 15th commence the consideration of a group of Bills comprising the Mid-Yorkshire Tramways, the Birmingham District Tramways, the Gosport, Fareham and Cosham Tramways, the Manchester Corporation and the Brighton Corporation.

Fife Electric Power Bill.—This Bill last week came before Lord Morley's Committee of the House of Lords on Unopposed Bills, and was ordered to be reported for third reading.

Carmarthenshire Electric Power Bill.—This Bill was before Lord Morley's Committee of the House of Lords on Unopposed Bills last week, and the preamble was formally found proved.

Wigan Corporation Tramways.—Last week this Bill, which is unopposed, was before the Chairman of Ways and Means in the House of Commons, and evidence having been given in proof of the preamble, the Bill was ordered to proceed.

Cleveland and Durham County Electric Power.—This Bill, which has already passed the House of Lords, was last week before the

Unopposed Bill Committee of the House of Commons, and was ordered to go for third reading.

Coventry Electric Tramways Bill.—On Tuesday last week the Standing Orders Committee of the House of Lords decided that Standing Orders might be dispensed with in the case of the petition for an additional provision to the above Bill, and that the Bill might be allowed to proceed.

Gosport, Fareham and Cosham Tramways.—This Bill was before the Standing Orders Committee of the House of Lords last week in respect of a non-compliance with regard to an additional provision to allow of a further line being constructed and the taking of other lands than those scheduled for generating stations. The Committee decided that Standing Orders might be dispensed with and the additional provision introduced.

Erith Tramways.—Wednesday, June 10th, has been appointed for the consideration of this Bill by a Select Committee of the House of Commons.

Scottish Central Electric Power Order.—A report has been presented by the Chairman of Committees of the House of Lords and the Chairman of Ways and Means in the House of Commons under the Private Legislation Procedure (Scotland) Act, that they are of opinion that the provisions of the Scottish Central Electric Power Order are of such a character that they ought to be dealt with by private Bill and not by Provisional Order.

LEGAL.

PATENT EXPLOITATION, LTD., *v.* THE AMERICAN ELECTRICAL NOVELTY AND MANUFACTURING CO., LTD.

(*Continued from page* 909.)

ON Saturday, May 23rd, Mr. ASTBURY, continuing his address, said he wanted to show his Lordship the two batteries, and then he would call his evidence. The defendants' battery was identical with the plaintiffs'. The article which the plaintiffs said was an infringement was identical with theirs.

His LORDSHIP: What are the issues?

Mr. ASTBURY replied that defendants had pleaded every possible defence.

His LORDSHIP: What is the real issue? In the previous case the issue was no infringement, but it is here.

Mr. ASTBURY: Yes; and although it has been proved that our battery, as a dry battery, has knocked every other battery out of the market.

His LORDSHIP: I suppose they will say there were other anticipations than those pleaded in the other case.

Mr. ASTBURY: Yes; they are also going to say that the case was not properly tried.

His LORDSHIP: Of course, these defendants are entitled to say the previous defendants misconducted the case.

Mr. ASTBURY: Oh, yes; they are entitled to start the case *de novo*. They are going to say ours is not useful, although it is the widest used battery. I understand they are going to raise some question about some vent-hole. I think my learned friends are going to raise all the issues they can. Continuing, the learned counsel said if his Lordship took the plaintiffs' specification, he would see that the defendants' prescription was identical with the plaintiffs', with the one exception that they substituted in the outer paste those several thicknesses of blotting paper in a damp or moist state for plaster of paris and flour.

His LORDSHIP: Is that an admitted fact or is it in issue?

Mr. ASTBURY: I should think it is an admitted fact; but I really cannot say, because they simply plead now infringement. I do not know whether Mr. Moulton will admit that, but that is our analysis of that. There is no mention about the sale, because they sold the battery, paid for it, and analysed it. They have the two electrodes exactly the same as we have. They have the carbon pole in the inside just as we have. They have the inner layer composed of sal-ammoniac, chloride of zinc, pulverised manganese, and pulverised carbon just as we have. In the outer layer they have all the chemical equivalents that we have, but they substitute this damp mass of blotting paper for plaster of paris and comminuted vegetable matter. For the purpose of considering whether the substitution of blotting paper in that state for plaster of paris and flour is an equivalent you have to consider two questions—first, what is the function of the outer layer in our battery as a whole; and, secondly, what are the functions of each constituent of the layer for the purpose of getting the total function as a whole. Now, if in the defendants' battery the layer as a whole performs precisely the function of our layer and each substance of the substituted ingredients performs the same physical or chemical function over the part for which it is substituted as in ours, it is the same as ours by the substitution of equivalents. Continuing, the learned counsel said that the flour was added to the plaster of paris in the plaintiffs' battery simply to get better porosity and to maintain semi-solidity against absolute solidity. Therefore having got the mass made with flour in that way, the function that the plaster of paris mixed with flour had, was to keep the chemical constituents of the outer layer in a form which would enable it to stand of itself. Without those it would simply be a liquid. The other function was that they were substances, which although they would keep the mass in a semi-solid, as distinct from a liquid state, would keep it in such a condition as that it would be a perfect filter of liquid or moisture, and enable the current to pass through its damp path from one electrode to the other. It also prevented the passage through it of the pulverised depolariser. Plaster of paris was a substance which, although it would let moisture through, would not let this powdered solid through; the blotting paper had every one of those functions *qud* battery purposes. His Lordship would be told by the witnesses that for the purposes of a battery, the blotting paper was an exact equivalent to what plaintiffs had. The plaster of paris and the flour performed no chemical or electrical action at all, and the blotting paper, therefore, *qud* a battery performed identically the function which the other two substances performed. That being so it was an absolute mechanical equivalent to plaintiffs'.

Prof. SILVANUS THOMPSON, examined by Mr. ASTBURY, said he had made a careful study of the plaintiffs' specification. He found the invention clearly described in that document. It was an unusually clear specification. He had carefully read and considered the whole of the documents cited in the particulars of objections as alleged anticipations. He did not find the plaintiffs' invention in any one of them. A battery constructed according to the plaintiffs' specification was a peculiarly efficient and useful battery. He knew of no battery, prior to the date of Hitchcock's specification, which had its efficiency or utility. He had seen one of the batteries the defendants sold. In his opinion, those batteries were constructed absolutely in accordance, prescription and invention, with the variation of substituting layers of blotting paper for the layer directed to be composed of plaster of paris and comminuted vegetable matter. The inner layer was identical with the plaintiffs', and the outer layer was the same with the substitution mentioned. The blotting paper and the flour played exactly the same function as the plaster of paris and flour mentioned in the plaintiffs' specification. The outer layer, as a whole, in the defendants' battery, performed exactly the same function as the outer layer performed in the plaintiffs' battery. He had a fair knowledge of the various known forms of batteries. Prior to the date of this specification of 1890, in the Leclanché type of battery, it was not considered advisable to pulverise the manganese. The state of knowledge was, that it should be rather crushed than pulverised. That was the common practice prior to the year 1890. The Volta was the earliest form of battery. The next form was the Bunsen or Grove battery—the two-fluid cell battery. Then came the Leclanché type of cell. That was not a two-fluid cell, but only a one-fluid cell. There were a large number of attempts to make dry cells, and Hitchcock solved the problem.

Is it possible in a battery constructed as the plaintiffs' for the creation of hydrogen film on the cathode such as was the case in the Leclanché?—I do not say it cannot be done, but in working conditions it does not occur.

Cross-examined by Mr. MOULTON, WITNESS said batteries were known for 90 years before 1890. Hundreds of arrangements of different materials to act as a voltaic battery had been proposed and used.

It was known that the form of the electrode was capable of being varied as you liked, only that it might affect the internal resistance, because you had a smaller area of electrode or a greater distance between the electrodes?—Undoubtedly.

And an extremely common form was a circular electrode of zinc surrounding a central block of carbon?—For those batteries in which low resistance was specially desired, and it was perfectly well known, but there were very few Leclanché cells made that way. They were made with a small stick of zinc and not a circular cylinder.

You might make the ring of carbon and the stick of zinc, or the stick of carbon and the ring of zinc. All this was A B C to anyone who knew anything about electricity at that time?—Yes.

The electromotive force, that is to say, the pressure which a battery produced, had been observed and calculated for all kinds of electrodes, had it not?—It was perfectly well known for all kinds of electrodes.

The Leclanché battery was characterised by having peroxide of manganese as its depolariser?—That was its characteristic particularly.

Such a battery was used for electric bells. It would not run down excepting by use?—It would not run down excepting by continuous use. May I explain how far I agree with you?

I do not want to deal with other points.—But there are two senses in which the words "run down" may be understood. If you press the button of the bell for an hour together, then the battery probably would not last out that hour. It would require time to recover; but it might run down in another sense by the chemicals being used up in a year or two, or 10 years, possibly.

Answering further questions, WITNESS said that many years before 1890 people had seen that it would be convenient to put something with which the nascent hydrogen would re-unite in the same way that the nascent oxygen would re-unite with the zinc at the zinc pole. Polarisation was the lowering of the pressure of the battery by reason of the deposition of a film of gas on the cathode. The principle of having a depolariser was introduced by Grove in 1843. A solid depolariser was used with great success by Leclanché. In the Leclanché the solid depolariser was peroxide of manganese. The Leclanché was invented in the sixties; 1866 was the patent. It came in about 1870. The substance used was really crushed pyrolusite and carbon, which was not exactly pure peroxide of manganese. It was the natural form of it, containing other things.

Suppose I have two plates in the pot, one of zinc and the other of copper, and the exciting solution is poured in. The pressure of that cell is determined by the fact that one is zinc and the other is copper?—Solely by the chemical constituents; perhaps I might say by the chemical constituents and their state or polarisation.

You put into the fluid any inert substance, asbestos, *papier maché*, sand, or anything you like, and fill it up so that it becomes a wet substance instead of being interrupted fluid?—A wet inert substance.

The pressure of the cell will not be altered?—No.

What will be altered will be the internal resistance of it?—Yes.

And that simply because you have blocked up, if I may say so, a lot of the space that the electrotyte used to occupy?—You have closed a lot of paths formerly available through the liquid.

As long as it is inert matter the result is the same; the only question is, how completely you have blocked up, or, rather, how inconveniently you have blocked up, the electrolyte?—Yes; the resistance depends on the degree to which you have blocked it.

There, again, that was perfectly well known?—Perfectly.

People had taken advantage of this for the purpose of making their batteries unspillable?—Yes, they had put sand in.

All sorts of things they had put in so as to render the battery capable of being moved about without spilling the fluid?—Yes.

"Dry cells" is a generic term for an unspillable battery—that is, a battery where inert matter has been put into the electrolyte to prevent the electrolyte being spillable?—That is generally so.

It was perfectly well known to all people who knew about batteries that you must not let your depolariser get at your zinc?—That was the object of the porous pot.

And the known object?—No, I do not know that everybody knew that was the reason.

But I mean every electrician knew perfectly well that he must keep his depolariser away from his zinc?—I think most electricians would; I am not sure.

I dare say we could find electricians to-day who did not know Ohm's law?—But there were batteries in which the depolariser was distinctly allowed to come to the zinc.

You are talking about bichromate?—Others as well.

A very common way of keeping the depolariser away from the zinc was by means of soaked blotting paper next to the zinc?—I do not know of it.

I will take the ordinary dry pile, the earliest that ever was. Dry piles were discs of metal with blotting paper between them, soaked sometimes with one solution and sometimes one with one and the other with the other?—I do not think they were soaked with solution at all. There was paper taken and rubbed over on one face with red lead and on the other silver leaf put on. Are you speaking of Zamboni's dry pile, the best known?

It was blotting paper, was it not?—No. It was like very fine writing paper.

Just look at the Skrivanov Letters Patent 15,065, of 1887. The specification reads: "According to this invention I form a battery of two elementary parts, one an attackable electrode, say, of iron, tin or zinc, the other a plate of retort charcoal, agglomerated charcoal, a sheet of lead or other conducting substance which cannot be attacked by the exciting liquid used. Over this conducting plate I spread a layer, say, of ·04 to ·12 of an inch in depth of red lead or minium, and I envelope the whole in a sheet of parchment paper or cloth or asbestos, which I retain with india-rubber bands, or by tying threads around it. The two electrodes are placed in a solution of hydrate of potash or hydrate of soda." He takes the zinc at the bottom—

Mr. Astbury: That is in the second. The first is a wet battery.

Mr. Moulton: The next one is, "By covering the positive electrode with several sheets of filtering paper or cotton or asbestos soaked in the above solution, and applying above it the negative electrode, a dry battery can be obtained." What do you understand by the positive electrode there?—A coated sheet of retort charcoal or a sheet of lead.

You put several sheets of filtering paper or cotton or asbestos soaked in hydrate of potash. Is not that so?—Yes.

Then over that you put the negative electrode?—No.

The positive electrode you said was the carbon, did you not?—Certainly.

That is the carbon with the minium in it——

Mr. Astbury: No.

Mr. Moulton: Yes, it is the carbon with the minium, has over it the blotting paper, and then the zinc is placed on the top?—So you say.

That is a perfectly good battery?—I do not agree with you either in the description of it, or in the statement that it would be a good battery. I understand that he takes his plate of retort charcoal—agglomerated charcoal with a sheet of lead—and on that he spreads a layer of red-lead, and envelopes that in a sheet of parchment paper or asbestos, which he ties on with india-rubber bands or threads. Then he places that in a solution of hydrate of potash or hydrate of soda.

Then he has got his filtering paper between his zinc and the depolarising material?—He has placed his filtering paper or cotton or asbestos in line 12 above the positive electrode.

I put it to you that you put round your carbon and minium blotting paper, and then you lay the zinc on it. It is quite clear?—I do not think it is clear.

What do you say it is?—It does not say in those lines from 12 to 14 whether there is any minium at all, or any sheet of parchment cloth or asbestos to tie it on.

Handed a sketch, Witness said that it represented the soaked blotting paper next to the zinc. It had the excitant in it. It rested on the minium and the minium rested on the carbon or lead.

The blotting paper there is doing exactly what the blotting paper in defendants' is doing?—It is possibly so.

It is?—It depends whether it is attacked by the alkaline solution. In potash of that strength paper would be acted upon.

Oh! Prof. Thompson?—This is not a working thing at all.

Hydrate of soda! Do you say that that is not perfectly intelligible that you could have blotting paper soaked in hydrate of soda? It is perfectly intelligible that you could do it. I do not say that it would make either the same thing you have or a working cell.

What I am putting to you is this: There you have got blotting paper doing exactly the same thing as in the defendants' cell?—No, not exactly doing the same, because the solution in this case will act upon it to swell it up.

In the electric combination I am talking about, it is doing exactly the same as in the defendants' cell?—If you say it is acting as an absorbent mass to take up the excitant, of course it is.

And filling up the space between the zinc and the depolariser?—Yes.

Therefore you have got here a fine powder on a carbon plate separated from the zinc by blotting paper charged with the exciting solution?—Yes.

Looking at it electrically, that is exactly the same as the defendants' combination?—No.

The carbon, solid depolariser in powder on it, blotting paper soaked with the excitant and zinc. How do you distinguish it from the defendants' combination?—The layer of depolariser is not mixed with carbon. It does not form a solid mass.

Stop a moment——

Mr. Astbury: I wish you would let him answer; you have asked him a question.

Witness: There is no direction to put hygroscopic material into it, and, as a matter of fact, it would not be a working cell for other reasons.

Mr. Moulton: The question of a working cell I will deal with afterwards. I will take this first. There is no need that carbon should be mixed with it, is there?—You will not get a good working cell unless you mix carbon with the depolariser.

Why not?—Because the surface of the carbon is not then led out into the mass round it. The whole object of mixing the carbon with the depolariser, is that there may be an extension of the conduction of the carbon into the mass.

Would you just look at the claim of Hitchcock. Is there anything about powdered carbon there?

Mr. Astbury: I object to that. That is a question of construction. The Court of Appeal have construed it.

Mr. Moulton: I am not asking him to construe it at all.

His Lordship: He has been asked whether he finds something here. That is all.

Mr. Moulton: Is there any reference to powdered carbon there?—Directly, no; by implication, yes.

Unless the "substantially as set forth" carries with it that there must be powdered carbon, there is no reference to powdered carbon being in the inner layer?—No, there is none.

I put it to you that hygroscopic materials were only put in the cells for the purpose of keeping them wet by taking moisture from the atmosphere, and that if the battery were closed they could not do it?—I do not know why they put them in in every case. I presume they did put them in as much to prevent moisture going into the atmosphere.

If the cell were closed they could not do it?—No.

Therefore they are useless in the plaintiffs' combination?—No. There is nothing in the specification to say there may not be a vent in the cell.

"Sealed around the carbon, c, with bitumen or other suitable material, a, substantially impervious to air and moisture," that is what he says?—He says the material must be impervious to air. He does not say there is to be no vent hole in the cell.

Where is the hole?—He does not show it.

I put it to you that for years after they made them closed, and they used to burst, and they had thousands returned?—I know nothing of the sort.

At all events, reading the specification and looking at the picture, it shows a closed cell in which the hygroscopic material could not exercise this function?—Could not exercise the function of absorbing moisture from the air or keeping moisture inside from going out to the air.

I put it to you, that that was the sole purpose?—It may have been the sole purpose, but it would not have been the sole effect.

What do you say is the effect in the plaintiffs' of having a hygroscopic present?—It is that it will equalise the moisture.

Why do you not equalise it at first?—I do not know.

I put it to you, that it is nonsense to suggest that the hygroscopic material has any object with reference to the equalisation of the moisture?—It may not be an object of the patentee.

And I say it would not be an effect?—Yes; I say it would be an effect. Really the circumstance that diffusion will of itself in time equalise the moisture does not prevent another thing also tending to equalise the moisture.

How does it act?—By forming a molecular combination with water.

How could the hygroscopic material usefully improve the effect of diffusion?—By doing the same thing—two means of doing the same thing instead of one.

Mr. Justice Buckley: As I understand, although the two layers start with quite a different proportion of hygroscopic material in them, one part in one and one-tenth part in the other, they would equalise themselves?—They would, in process of time, equalise.

Mr. Moulton: Why don't you start with them equal?—I cannot tell you why the patentee did not start with them equal, but I can only conclude that he had some reason. Such, for example, that there is water of crystallisation in one of the materials that would alter in time.

He says the proportions may be altered?—No; he gives you the best proportions he knew of.

You see no reason whatever in a closed cell for having hygroscopic material?—I have no doubt there is a reason, but I do not happen to know.

So long as it is closed, I put it to you that the plaintiffs' battery is exactly as good without the hygroscopic material?—It may be.

Are you prepared to say it is not?—So long as it is absolutely closed, without any vent or cracks.

I put it to you that there is not one battery on the market made in

accordance with the receipt in the specification?—I am not aware of any substantial departure.

What is the physical condition of the inner layer if made in the way it is described from line 20 to 24?—It will be semi-solid.

I put it in this way: It is totally unlike the cells on the market?—I don't agree with you. It is more fluid than the state in which you find the stuff if you open a cell after having been made some months.

You know nothing of the early history of the manufacture?—Nothing whatever.

It was perfectly well known that you might, with no other effect than altering the internal resistance of the cell, put inert matter into the electrolyte until it became unspillable?—Yes.

All that inert matter that is put into the plaintiffs' combination is for that purpose?—I suppose so.

Now, the effect of putting that in is to make a semi-solid plastic mass?—Yes.

Both in the plaintiffs' specification, and in all the other cases in which it used to be done?—Oh no.

Take *papier maché* or asbestos. Does that make it a semi-solid or plastic mass?—I don't think asbestos makes a plastic mass. *Papier maché* does certainly.

Does not finely comminuted asbestos make the electrolyte into a semi-solid or plastic mass?—I think finely comminuted asbestos would.

It was well known to put layers of asbestos paper in order to render the electrolyte unspillable?—I have seen it done.

I put to you that that is exactly the same electrically, and exactly the same mechanically and physically as putting in blotting paper?—It is very much the same.

You draw no distinction between the two?—I draw no essential distinction between the two.

Take sawdust or asbestos or sand in a dry cell. I put it to you that there will be no movement of the carbon particles at all?—Yes; the diffusion of the liquid will move them.

Could diffusion move a solid particle?—It does.

I put it to you that such a danger is for all practical purposes non-existent?—I think that that is disproved by the reason that no successful battery was made until we had these instructions from Burnley.

I put it to you that any such danger as the carbon particles making excursions through a plastic layer produced in the old fashion of asbestos sawdust or *papier maché* is practically non-existent?—It depends on the close-grainedness of the plastic material so called.

Kindly tell me where that is pointed out in the specification.—It is not pointed out in the specification.

Can you tell me anything in the specification to show what things will stop the carbon from emigration, and what will not?—No; I don't think the patentee gives instructions on that point.

Does he give any instructions which show whether you could safely leave his prescription or not?—No; the general instruction is that one layer must have no depolarising material.

I ask you does he give any directions which show how you can safely leave that prescription?—No, I think there are none.

The further hearing was adjourned.

On Monday, May 25th, Prof. SILVANUS THOMPSON was further cross-examined by Mr. MOULTON.

You have told his Lordship that you consider blotting paper to be equivalent to that which is described between the lines 11 and 16 of the plaintiffs' specification?—Yes.

Can you point out anything in the specification to indicate that?

His LORDSHIP: Indicate what?

Mr. MOULTON: To indicate that it is an equivalent in the specification, my lord.

The WITNESS said he thought what he said was, that the blotting paper as a filter, was an equivalent.

I want you to point out anything in the specification that is within the claim, and is an equivalent to what is described?—I do not think there is anything.

Therefore, no one reading this specification would learn from it that he was not to use blotting paper?—I should rather put it that there was nothing here directly to suggest that blotting paper so prepared was an equivalent.

Cross-examination continued: He did not remember any previous prescription like the plaintiffs', and, therefore, he thought it was a novel composition.

Will you tell his Lordship from the specification what things are included—what outside layers are included, and what are not included in the specification?—Do you mean as equivalents for the outside layer as that is given here?

I am not going into the question whether equivalents are, or are not, included here. But I want you to tell his Lordship what outside layers are included in the invention and what outside layers are not included.

Mr. ASTBURY: That is a question of construction.

The WITNESS was understood to say that he could only express a scientific opinion upon the matter.

Mr. MOULTON: No. This is an invention consisting of an inside layer, an outside layer, and electrodes, and you must be able to get from the specification what outside layers are included, and I want you to point out to his Lordship what they are?—As I understand it, my Lord, the description as given here is a description of a semi-solid or plastic material of which a composition is given, which composition will have certain properties.

May I take it that you consider any semi-solid or plastic body is within the invention?—No, certainly not, unless it has these properties.

Show me anything which points, which gives directions, that blotting paper is within the specification.—It must be a material which is a semi-solid and is to contain hygroscopic material, and it has to fill up the space between the two electrodes.

It was common knowledge to mix chloride of zinc with sal-ammoniac in cells of this kind. Now let us go to the inner layer. We have already got that the inner layer made according to the specimen is a pasty mass?—Yes.

You have not had any special experience with dry cells during the last fifteen years?—No very special experience.

Can you speak right back to 1890 as to the cells in the market?—Yes, I think I can.

What were you using in 1890?—I used very few of them, because they were not good. I used, preferably, Leclanché. I used afterwards Skrivanov and then Gassner. The Leclanché batteries were widely known.

It was perfectly well known that the carbon was for the purpose of, as it were, increasing the conducting power of the carbon pole, and the peroxide of manganese was the depolariser?—The last point was certainly known—I am not sure about the first.

But they knew why they put in the carbon?—I should have said so. I should have given them my answer. I do not know whether it was generally known.

There were many electricians who I am sure you will say were quite as likely to know as you?—If they had been forced to think about it they would have said so.

Do you mean to say that the electricians in 1890 did not know what the carbon was there for?—I think they thought it was there for something else.

At all events, they put it there?—They put it there, and it unquestionably would have that effect.

And they knew it would have that effect?—They might have known; some of them certainly did.

That will do for me. Now let us see what Leclanché himself knew many years before. Just look at the two specifications of 1866.—One, my Lord, is called Brandon.

His LORDSHIP: The first one is only a provisional.

Mr. MOULTON: The first one is only a provisional, my Lord, and the second is completed. They are both of them Leclanché. I will take the second. On page 3 of No. 2,623 of 1866, he says:—"I take a glass jar with a large neck, into which I introduce a porous cell or vessel destined to receive a plate of carbon or graphite, such as is obtained from the lining of gas retorts, and to which I attach a metallic wire acting as the positive pole, and I fill the porous vessel with peroxide of manganese reduced to powder, or with a mixture of peroxide of manganese and powdered graphite." Therefore, at that time he knew of, and proposed for, the central parts of his battery, powdered graphite and peroxide of manganese?—Yes.

"The conducting wires are passed through holes made in the cork or bung, which closes the neck of the jar, and in the centre of the said cork I make a third hole into which I insert a small glass tube"——

Mr. ASTBURY: Are you not going to read the intermediate part?

Mr. MOULTON: I beg your pardon. "I then fill up the jar with sand, or sawdust, or other granulated substance which will thicken the water, and I place in the same a plate of zinc provided with a metallic wire acting as a negative pole." Now I see they put sand, or sawdust, or other granulated substance which will thicken the water. Of course *papier maché*, or asbestos, or anything of that kind would do.

Mr. ASTBURY: *Papier maché* is not granulated.

The WITNESS: Anything that is granulated, certainly.

Mr. MOULTON: With the knowledge of the world at the time, they would know perfectly well they might put in anything of that kind?—I do not think they would have thought of *papier maché*. They might have thought of asbestos, certainly.

Supposing he fills the porous pot with this powdered peroxide of manganese and graphite, and then outside the porous pot had this sawdust, as I will put it, and then "the entire mass of sand and peroxide of manganese is moistened with a concentrated solution of hydrochlorate of ammonia." That is sal-ammoniac?—Yes.

Electrically, that is an ordinary Leclanché battery?—It is.

So is the plaintiffs'?—Yes.

In both cases the layers are wet solid substances?—Yes.

And the fluid that wets them is sal-ammoniac?—Yes.

With the exception of his using a porous pot to keep the two layers apart, can you tell his Lordship any difference between that cell and the plaintiffs'?—I think the differences are these. That there is no hygroscopic; that the material outside the porous pot will not be in the plastic condition.

You do not mean to tell me that if blotting paper is plastic, sawdust and water, or asbestos and water, is not plastic?—Sand and water will not stand up in the same way as blotting paper.

Now, do you consider it would have been invention to change the plastic outside layer of the earlier Leclanché which we have just been dealing with for blotting paper?—Not in itself.

Therefore, I may take it that you do not think it would have been novel to have a porous pot full of powdered peroxide of manganese, and carbon surrounded by blotting paper, and sal-ammoniac poured over it?—Not useful.

It would not be novel?—Yes, in some respects.

There would have been no invention in using that porous pot full of that mixture with blotting paper outside and doused with sal-ammoniac?—No.

That is all I want to know. Therefore the invention of the plaintiffs is leaving out that porous pot where it was not needed?—No; that is one part of the invention.

Will you tell me any other part?—Well, he is only able to do that because he substituted a substance which is different from the sand which he had before. There are two stages in it, neither of them by itself might constitute an invention.

I understand what you say now. Tell me anything else?—Nothing else occurs to me at the moment.

The witness was then referred by the learned counsel to a battery described in Skrivanov, No. 489, of 1882. WITNESS stated that the process for making a paste described by Skrivanov did not give a precipitate that was insoluble. He had really misdescribed what he thought he had. The Skrivanov batteries failed because the paste that he produced was not porous.

Were you not on a committee that gave an award of a medal to Skrivanov for this very battery?—No, another battery.

WITNESS, further cross-examined, said that Skrivanov's figure 2 had paper over the top of the paste between that and the zinc. That was for the purpose of keeping the paste from the zinc.

Now, I put it to you, what difference do you say there is between that and what is included in the plaintiffs' specification?—There are several small differences besides the main difference of chemicals; that this is not a dry Leclanché, and this paste is not a porous paste.

The WITNESS was then referred to Walker, No. 883, of 1883. He said that there the inner layer was not pasty. His experience of the agglomerate blocks there was that they did not become pasty when they were put into the cell. Walker's was a method of getting a layer, but it was a special method applied in a different case, and it produced certainly, in his experience, a different result. Questioned with reference to Jensen, the witness admitted that he was the inventor of the Hellesen dry cell. His claim was "the application and employment of oxides and superoxides of the heavy metals," and that would include binoxide of manganese. There the zinc was in the liquid outside. It was not a dry cell at all. It was an ordinary wet cell, like a Leclanché. It was a simple Volta cell made in a particular way. There was nothing to tell you how to make a dry cell. It would not lead you towards the plaintiffs' invention.

It is the defendants' cell, is it not?—I do not think it is. I think it is the ordinary open wet cell.

He puts quite clearly the carbon surrounded by hard rammed binoxide of manganese and graphite, and with porous paper outside—parchment paper outside?—Suitable fabric bound round, he says.

If that is put into a zinc cylinder of that size it is then the defendants' cell?—It would be very like the defendants'.

Is there any difference?—Yes; considerable difference.

What difference?—It is not sealed up, and there is no chloride of zinc in it. Those are the two points.

The witness was then cross-examined as to Dymond's complete specification, No. 18,754 of 1888. He said that there the internal layer was a coal brownstone electrode. The agglomerate electrodes of carbon and binoxide of manganese, carbon and brownstone were sometimes baked and sometimes not.

Take one that was not baked. How did that differ from the plaintiffs' specification?—It would require a carbon rod. That is the most important point. Then another point was that the plaintiffs' specification was a thing that had to be sealed.

Cross-examination continued: He did not suggest that there was any invention in putting a carbon centre to this coal brownstone electrode. The differences between Dymond and plaintiffs, were differences of detail. In Castle-Smith the paste described would act perfectly as the outer layer.

How does that differ from the plaintiffs'?—It differs in the following respect, that plaster of paris cannot be used for it, according to the patentee. The witness said that in Castle-Smith the outer liquid was described as phlegmy, and it is obviously sufficiently liquid to render a bag necessary to hold the depolarising paste against the electrode. The canvas bag showed that the layers would not stand up of themselves; the inner layer, for instance, required to be held up. That made a difference to the practical working of the cell.

Why?—Because if the depolarising substance can fall down, it is not such as can hold itself up against the carbon; or if it is not held up against the carbon, being unable to hold itself up, then the material will not be able to perform its proper function. Plaster of paris was a better material than tragacanth.

You do not say that there is any difficulty in making a depolarising paste?—No, but there is no description how to do it here.

Look at this extract of July 21st, 1889. "A dry cell presenting some novel features has lately been brought out by M. P. Germain, belonging to the French Telegraph Service. The material employed by M. Germain is cellulose, prepared from cocoanut fibre." This battery is used enormously in France, is it not?—I believe it is.

"This material is cheap, is a good conductor, and possessed of great absorptive properties. In the Germain modification of the Leclanché cell the carbon plate, surrounded by a mixture of powdered retort carbon and binoxide of manganese, rests underneath a cellulose pad soaked with a solution of sal-ammoniac; on the top of the cellulose there are two sheets of zinc. Four powerful springs press the cellulose pad tightly against the layer of carbon. Laboratory tests show that this cell does not polarise nearly as rapidly as the Leclanché, and is capable of giving comparatively powerful currents for short periods." That is a great advantage over the Leclanché, because the defect of the Leclanché was that it would not do that?—It polarised too quickly.

That was a dry cell, and had got carbon and zinc as the electrodes, and round the carbon was a damp powder composed of binoxide of manganese and carbon powdered and soaked with sal-ammoniac. Then there was a cellulose pad which was the same as defendants' blotting paper. The main distinction between that and the defendants' was that it was a dry open battery, requiring water to be added from time to time.

Can you point his Lordship to any other distinction between this and the defendants' cell beyond that it would require water added to it?—No other distinctions except such as are necessitated when you close the cell. When you close the cell then you begin to have the other question of moisture. You would no longer be able to add water when the cell was closed.

Therefore I may take it that if this was closed it would be the defendants' battery?—No, because they do add hygroscopic.

But you say it makes no difference whether they do or not?—It does, it makes the cell a better cell.

You say if this is closed the only difference between it and the defendants' is that there is no chloride of zinc added?—That is the only chemical difference; there are mechanical differences.

What are they?—The disposition of the pastes in cylindrical form round one another.

You have told us those forms were perfectly well known and interchangeable?—Yes, but the patentee who arrives at a useful form and introduces that useful form has done something to the credit of which he is entitled.

Now I come to the Thiebaut group. With regard to Thiebaut there was a fundamental patent and three patents of addition, I think?—Yes.

That is the method whereby small improvements of an original invention are patented?—Yes.

This was a circular cell, zinc outside and carbon inside as an electrode?—Yes.

The learned counsel then read to the witness certain passages from Thiebaut, and from the third certificate of addition of Thiebaut in which was the following passage: "The object of the present addition is to indicate the various chemical compounds producing by their application to my system of dry cells, results analogous to those which I hitherto obtained with peroxide of manganese. I have noticed that I can substitute for the peroxide of manganese, which is not always handy, pure peroxide of lead, or conveniently, minium, a mixture of peroxide and protoxide of lead, a substance well known in commerce." These are powders, of course?—Yes.

So that we have in Thiebaut the powdered depolariser and graphite in grains or carbon grains?—Broken up I think it is, *concassé*.

Then sal-ammoniac is an excitant, and outside a layer of plaster of paris and sal-ammoniac which has set?—And cooking salt with it.

Just tell me where that differs in that last form from the plaintiffs' specification?—Not so much in form as in composition, because sal-ammoniac would not be the right excitant if you used peroxide of lead or minium.

But it would work, would it not?—It would work for a short time. It would form chloride of lead, which is bad. I certainly do not think it would make a good cell.

Further cross-examined, WITNESS was referred to Gassner's United States patent of 1887. He said there the plaster mixture was not identical with the plaintiffs'. The chemical composition was different, but played the same part. Gassner had not got a second plaster layer. The witness was then re-examined by Mr. ASTBURY, and the hearing was adjourned.

(To be continued.)

PROSECUTION OF THE CHARING CROSS AND STRAND CORPORATION.

AT the Mansion House, on May 29th, the Charing Cross and Strand Electricity Supply Corporation, Ltd., were summoned for that they, on or before July 12th, 1901, at the corner of Mincing Lane and Fenchurch Street, did begin to execute a work respecting which they ought to serve a building notice under the London Building Act, 1894, before serving such notice. We are indebted to the *Times* for the following account of the proceedings:—

The work referred to in the summons was the construction of an underground chamber in connection with electric light wires. There were six other similar summonses in respect to the construction of such underground chambers in other parts of the City. The summonses were issued at the instance of the district surveyor under the London Building Act, 1894, for the eastern division of the City, and they had been adjourned from time to time pending a decision of the High Court as to whether the underground chambers were "buildings" within the meaning of the Act. Mr. Bale, solicitor, appeared in support of the summonses; Mr. F. F. Daldy appeared for the defendants. Mr. Bale said that the Building Act provided that where any building, or structure, or work was about to be begun a building notice respecting it must be served on the district surveyor. The buildings in this case were underground chambers in connection with electric light wires. The chambers were 7 ft. or 8 ft. square. The question arose as to whether they were "buildings" within the meaning of the Act; and, although there was a decision of the High Court, the defendants wanted to have the matter decided again. Some other similar summonses had been issued from the Guildhall, and the magistrate at the Guildhall convicted. The case was thereupon taken to the High Court. The present summonses were issued in December, 1901, and had been adjourned from time to time by arrangement. The case in the High Court had been decided against the defendants. The matter now resolved itself into a question of penalties and costs. He should only ask for a nominal penalty, and an order for a substantial amount of costs. Mr. Daldy, for the defendants, said that this was not a case of an offence. People were justified in doubting whether an electric light box in the street, which was really nothing more than a local enlargement of the electric conduit, was a building coming within the Act. Sir Joseph Savory asked what penalty was imposed by the magistrate at the Guildhall. Mr. Daldy replied that the penalty was 1s. on each summons. Sir Joseph Savory said

he thought that a nominal penalty of 1s. on each summons would suffice. He should make an order for £10 10s. costs on the first summons.

INSTITUTION OF ELECTRICAL ENGINEERS.

The discussion on the papers by Mr. A. D. Williamson and Mr. A. B. Chatwood was concluded on May 14th.

Mr. Mavor (Glasgow) congratulated Mr. Williamson on the large amount of valuable information contained in his paper; he had himself collected a good deal of data relating to working costs in cases of electrically-driven machinery. The best examples were weaving and spinning factories, and the worst—engineering shops. He had roughly compared the results given with those of a spinning mill in Lancashire. Eliminating repairs and depreciation as not being directly comparable, he found the most startling difference in wages per unit, which in the latter case were ·034d. He wished to emphasise the possibility of employing cheap labour in connection with motor-driven plants—a feature as yet unappreciated. Mr. Mavor favoured the use of low-speed units; the commutator surface speed being low, but little attention would be required. From the author's remarks, he imagined that breakdowns in the generating units were infrequent, which was a point in favour of using a less number of larger units. The real argument for adopting electric driving was the possibility of introducing economical generating plant. Mr. Mavor further drew attention to the advantage of using the "outside armature" type of motor, previously introduced by himself.

Mr. D. L. Selby Bigge (Newcastle-on-Tyne) found himself in agreement with practically everything contained in Mr. Williamson's paper. He agreed with Mr. Mavor as to the desirability of reducing the number of generating units, suggesting that two units, and even one large unit, under certain circumstances, would give greater economy. He, personally, used bare conductors wherever possible, and thought that a thin insulation would quickly perish. For small tools he had found circuit breakers to be unreliable, and usually grouped such tools on distributing boards with fuses. From inquiries and personal experience of a number of cases, he had found that the saving, in substituting electrical for steam power, varied from 35 to 50 per cent.

Dr. Wissengrund advocated that electrical and machine tool engineers should work more in unison, recognising that the motor is a component part of the machine.

Mr. Allen (Bedford) gave his experiences when designing their new works some years previously. His firm had found that half the power was absorbed by the shafting and half in the machine tools and work done. In the matter of tools it was surprising what slight improvements had been made in their efficiency. With a view to saving a portion of the energy usually lost in belt transmission, his firm were driving their machinery direct from the line shafting—a clutch transmitting the power from the shaft to the speed cones—thus dispensing with countershafts and a great deal of belting. This had effected a saving of 25 per cent. in power. Their experience was that half the tools in the shops were running at the same time; if it was desired to work any particular tool overtime, this was effected by means of a portable motor.

Mr. Fairfax thought that motor makers might make more use of mechanical speed-reduction gears attached to the motor, to reduce the speeds to somewhere near those used in line shafting. He had introduced an arrangement of speed-reducing pulleys, the reducing gear being contained in the driving pulley, which is mounted on the armature shaft. By having four such pulleys with an outer bearing, a speed reduction of from 880 to 600 revolutions could be obtained.

Mr. Russell gave some interesting particulars of the Silvertown factory, in which electrical driving had replaced many of the older steam engines, and was used in all the new shops. Their plant embraced 150 motors of 3,800 H.P., in sizes varying from 1 to 150 H.P. The maximum load was 1,200 KW., and the average 300 KW., this small figure being due to running all night for one or two machines. His firm made it a general rule that any machine requiring over 5 H.P. should have a separate motor; occasionally groups of tools were driven by two or more motors. He considered it uneconomical to use motors of less than 5 H.P. In the matter of speed-reducing gear, he had used all the forms mentioned, and, in addition, worm gearing for slow-running machinery with heavy and variable loads. The wear on the worm and thrust bearing was inappreciable after two years, and it also took little room, and ran silently. In the matter of first cost worm gear is 15 per cent., and chain gear 25 to 50 per cent. higher than spur gear. He had had good results with smooth-core motors on fluctuating loads, and had been compelled to give up using circuit-breakers owing to their uncertain action, and to revert to fuses.

Mr. E. K. Scott thought that all motors should be provided with fly-wheels or heavy armatures, or be built on the outside armature system to compensate for the loss of fly-wheel effect, which occurs when line shafting and pulleys are discarded. Mr. Scott also took the opportunity of dragging the "polyphase herring" across the trail; unfortunately his remarks were not calculated to emphasise the good features appertaining to polyphase motors.

In the course of further discussion the low works costs shown by the Electric and Ordnance Accessories Co. with a Dowson gas plant was commented on, surprise being expressed that this method of driving had not been adopted at the other works.

Mr. Patchell considered that both polyphase and direct-current systems had their own special applications for which they were most suitable.

Mr. Robert Hammond, after referring to the value of results obtained from actual practice, mentioned that the costs of production at the Sheffield works should convince the most sceptical of the possibility of producing and distributing electricity at 1d. per unit. He was anxious to know how it is that coal reaches so high a figure per unit compared with the published returns of municipal stations with much lower load factors.

Mr. Patchell observed that a greater difference really existed as Messrs. Vickers' figures represented all units generated, while the municipal cost refers only to units sold. Further comments will be communicated by Dr. Rhodes and Mr. Drake.

Mr. Chatwood offered a few remarks on the discussion, and considered the 25 per cent. saving mentioned by Mr. Allen as the result of abolishing top-gear would be much increased in a small shop, and also in that case a proportion of two machines running out of 10 would be nearer actual practice.

Mr. Williamson, replying to the discussion, mentioned that he could not remember any breakdowns in engines and dynamos, but the trouble was rather with the boilers. In the matter of insulated conductors they were necessitated by the numerous telephone wires about the works, and the insulation had not perished during six years' use. Nearly all recent additions in motors were of the variable-speed type, owing to their past favourable experience. After looking through many large European works, he had seen no practical alternating variable-speed motor, also he did not consider a three-phase system of much value in small areas. In the matter of speed reduction, Mr. Fairfax's gear did not appear to have sufficient range. Worm gears gave 85 to 90 per cent. efficiency running in oil, but they were too expensive, and not so efficient as spur gearing. Slotted armatures were cheaper, as well as stronger, than the smooth type; the former consideration was a preponderating one, and, in their experience, commutators gave no trouble. The gas engine plant at the Electric and Ordnance Accessories Co. was a recent addition, and would, no doubt, be adopted in future; their economy was only appreciable when the Mond gas plant was large enough to enable the bye-products to be utilised. In the matter of high coal costs, this might be due to the small units and also to the considerable amount of steam-driven auxiliary plant, which would probably be replaced later on.

The meeting ended by a demonstration of the working of the Richmond Carey electric lift, by the inventor. The lift requires no attendant, being operated by the passenger, who has a series of selective buttons provided for his use in the cage, and on the various landings. A full description and diagram of this lift was given in our last issue.

The discussion, as a whole, was rather disappointing, considering the numerous practical examples of motor-driven plants, both on the direct and polyphase systems, with independent generating plants and in connection with our northern municipal undertakings which are working at the present time.

Annual Meeting.

The annual general meeting of the Institution was held on May 28th. The report of the Council went in detail into the large amount of work done by the Institution and its staff during the year. It showed that since the last annual meeting 35 new members, 135 associate members, 155 associates, and 229 students had been elected, making a total of 554. 58 candidates had been approved for ballot at this meeting, 23 associate members, 2 foreign members, and 14 associates have been transferred to the class of members; 203 associates and 3 students have been transferred to the class of associate members, and 61 students to the class of associates. 14 members, 3 associate members, 16 foreign members, 52 associates, and 12 students have resigned since the date of the last report.

The Council has awarded the following premiums for papers and communications:—

The Institution Premium, value £25, to Dr. J. A. Fleming, F.R.S., for his paper entitled "Photometry of Electric Lamps."

The Paris Electrical Exhibition Premium, value £10, to Mr. M. B. Field, for his paper entitled "A Study of the Phenomenon of Resonance in Electric Circuits by the Aid of Oscillograms."

Two Extra Premiums, value £10 each, one to Messrs. A. D. Constable and E. Fawssett jointly, for their paper entitled "Distribution Losses in Electric Supply Systems"; and the other to Dr. W. M. Thornton, for his paper entitled "Experiments on Synchronous Converters."

An Original Communication Premium, value £10, to Messrs. A. Russell and C. C. Paterson, for their communication entitled "Sparking in Switches."

Students' Awards—A premium, value £7, to J. Griffin for his paper on "Synchronous Electrical Machinery."

A premium, value £5, to F. J. Hiss for his paper on "An Analysis of Some Points in Three-Phase Motor Design."

A premium, value £5, to E. Fisher for his paper on "Three-wire System of Electric Lighting by Continuous Current."

A premium, value £4, to A. G. Ellis for his paper on "The Paralleling of Alternators."

A premium, value £3, to T. H. Vigor for his paper on "The Photometry of Electric Lamps."

Salomons Scholarship.—The Council has awarded Salomons Scholarships, value £50 each, to Mr. G. B. Dyke, of University College, London; and to Mr. H. W. Kefford, of the Central Technical College.

David Hughes Scholarship.—The award of the David Hughes Scholarship, value £50, has this year been made to Mr. W. H. Wilson, of King's College, London.

The Building Fund, which at the commencement of the year 1902 stood at £9,397 18s. 9d., was, on December 31st, £10,691 1s. 11d. The increase included a sum of £800 transferred from the surplus income, and a sum of £15 presented by the Engineering Society of

the Finsbury Technical College. The Council expresses its satisfaction at having also received during the later portion of the session a donation of £76 19s. from 637 students of the Institution.

Local Honorary Secretaries.—During the session Mr. R. H. Krause has retired from the office of local honorary secretary and treasurer for Austria-Hungary, owing to his change of residence, and Herr A. Von Boschan has been appointed in his place. Mr. John Hesketh has succeeded Mr. R. O. Bourne as local honorary secretary and treasurer for Queensland, on the appointment of the latter as Commonwealth Public Service Inspector; and Mr. James Oldham is now local honorary secretary and treasurer for Uruguay in place of his brother, Mr. John Oldham. Mr. W. Grigor Taylor, on leaving the East, has been obliged to give up his office of local honorary secretary and treasurer for the Straits Settlements.

At the suggestion of Mr. H. H. Kingsford, the Secretariat for Peru and Mexico has been divided, Mr. Kingsford retaining the office of local hon. secretary and treasurer for Peru. No appointment has yet been made to the Mexican secretariat.

Visit to America in 1904.—The Council has received and accepted an invitation from the American Institute of Electrical Engineers to visit the United States in 1904. The McGill University of Montreal has invited the two institutions to hold a joint meeting in their building at the same time. The invitations, both from the American Institute and from the McGill University, are couched in the most cordial terms, and the Council hopes that it may be possible to arrange not only for a visit to the Eastern States of America and to the St. Louis Exhibition, but also for the proposed joint meeting in Canada.

National Physical Laboratory.—Prof. Ayrton's period of office as a representative of the Institution on the General Board of the National Physical Laboratory having expired, and he being ineligible for re-appointment, Mr. Robert Kaye Gray has been nominated by the Council to serve in his stead.

Work of the Institution.—The work of the Institution continues steadily to increase, both in amount and importance. During the past year there have been 21 committees at work; 16 general meetings, four special general meetings of members, 26 Council meetings, and 93 committee meetings have been held.

INTERNATIONAL TELEGRAPH CONFERENCE DINNER.

An interesting function took place on the 28th ult., when the Submarine Telegraph Companies entertained the delegates and a number of distinguished visitors to dinner at the Hotel Cecil.

Sir John Wolfe-Barry presided, and was supported by the Marquis of Tweeddale, Sir John Denison-Pender, Sir A. J. L. Cappel, Commodore E. Suenson, Messrs. J. H. Tritton, E. N. Underdown, R. K. Gray, G. G. Ward, and other well-known representatives of the cable companies; while amongst the guests, who numbered about 450, were Lords Strathcona, Allerton and Kelvin, Sir Henry Mance, Sir H. C. Fischer, Sir H. Tozer, Sir W. H. Preece, Profs. Ayrton, Perry and Thompson, Messrs. J. C. Lamb, St. J. Brodrick, G. von Chauvin, W. Shuter, Dr. A. Muirhead, and other leading scientific and official gentlemen. Most of the guests were accompanied by ladies, and the scene was both animated and brilliant.

After the dinner, the Chairman briefly proposed in turn the healths of "Their Majesties the King and Queen, and the Rulers of all Other Countries," which were cordially received. The Chairman then proposed "Success to the International Telegraph Conference," and offered a hearty welcome to the ladies and representatives of foreign administrations. From small beginnings in 1851 and 1858, he said, the Conference had grown until it became of world-wide importance. It was not until 1871 that the Submarine Cable Companies were admitted to the Conference; he hoped that all the delegates would admit that that departure was a salutary one, and pointed out that no less than 199,000 miles of cable were owned by the companies represented at the dinner. Previous meetings, in which the companies took part, were held at St. Petersburg in 1875, London in 1879, Berlin in 1885, Paris in 1890, and Buda-Pesth in 1896. They were now proud to welcome the delegates once more to the old City of London. The Cable Companies wished the delegates a most hearty welcome, and greeted them as friends and comrades. Friendly conference ensured the exchange of ideas and the cultivation of broad views. He hoped that the dinner would be agreeable to the guests, and would also be useful in furthering the objects of the meeting. Harmony should prevail on such an occasion; hence the dinner would be followed by a musical programme, and he hoped that the Conference would compare favourably with its predecessors. With the toast Sir John Wolfe-Barry associated the names of Mr. J. C. Lamb, Second Secretary to the British Post Office, and M. Delarge, the *doyen* of the Conference.

Mr. J. C. Lamb replied in French, pointing out the influence of telegraphs in promoting peace and friendship, and expressing the appreciation of the delegates for the magnificent *fête* which had been provided for them, and for the kind words uttered by the chairman. M. Delarge also replied in similar terms.

The guests then adjourned to the Victoria Hall, where the Blue Viennese Band, which had performed at intervals during the dinner, and a number of accomplished artists, carried out an enjoyable programme of songs, violin solos and orchestral pieces. We should not omit to mention the admirably-executed souvenir menu and programme, illustrated with beautiful allegorical designs by Mr. A. Dudley.

CORRESPONDENCE.

The Baltic Mercantile and Shipping Exchange.

In your article under the above heading, I note that you take serious exception to the use of steam-driven fans and pumps, and while I am quite in accord with you, I should esteem it a favour if you will correct the possible impression that I am responsible for this portion of the work.

The scheme was arranged and estimates accepted for this contract before I was called in with regard to the electrical work.

Thanking you in anticipation—

Adrian Collins.

London, E.C.
May 29th, 1903.

[If our correspondent will kindly refer again to the article in question, we think he will find it quite clearly stated that we found no fault with the part of the work for which he was responsible; but we can readily appreciate his desire to be dissociated from the unfortunate design of some other portions of the scheme.—Eds. Elec. Rev.]

Municipal Electricity Undertakings.

So long as people do not all think alike and think aright, so long will difference of opinion exist. I do not for a moment hold the egotistical notion that I always think aright, but I am always prepared to argue my point after I have taken the trouble to rush into print. It may be, as in the present case, that the journal publishing my articles does not quite agree with me; all credit to the journal for publishing it.

The question which is causing so much doubt, and over which such diversity of opinion is expressed, is of a purely financial nature.

When can a municipal electricity undertaking be said to be a paying concern?

I hope my readers will forgive my method of argument; it may not appeal to everybody, but I think the logical mind will appreciate it.

I take it as an axiom that a municipal electricity undertaking is paying, at a standstill, or is losing according as the ratio

$$\frac{\text{actual value of plant}}{\text{total borrowed capital}}$$

is increasing, constant, or diminishing.

The rate of variation of this ratio may be taken as an indication of the prosperity (or otherwise) of a municipal electricity undertaking. The argument is, of course, applicable to any municipal undertaking, but we are at present concerned only with electrical matters.

It is assumed here that originally the whole of the capital was borrowed. As time lapses, the borrowed money is gradually repaid, but, of course, the plant has been depreciating. The above ratio says that a municipality must, to be prosperous, take such precautions that the rate at which it is repaying borrowed money always exceeds the rate at which the plant is depreciating in value. A time will then come when the whole of the borrowed money is repaid, and the municipality will at that time be the gainer by the value of the then existing plant.

The amount which should be allowed for depreciation cannot altogether be gauged by experience since, as I have already pointed out, plant may become obsolete before it is worn out. To my personal knowledge there are not wanting cases in which the whole generating station plant has been replaced in less than ten years in order to instal more up-to-date machinery. On the other hand, there are instances of obsolete machinery now running at a loss, because those in control think that it should not be discarded till it falls to pieces!

I fully appreciate any criticisms on opinions which I have advanced, but I challenge anyone to prove that a municipality is working at a loss if its balance-sheet shows a profit when depreciation is allowed for on the lines I suggest.

Municipal business should be conducted on perfectly safe lines, or not undertaken at all. If private concerns choose to speculate it is no concern of ours, but where the rate-

payers' money is at stake, those in authority should take care that they do not betray their trust.

Corporations have a monopoly, and, being freed from competition, are not called upon to proceed on other than safe lines.

The only insinuation which is implied in my article, and which may hit the mark, is that municipal business does not receive the same careful and anxious attention that is given to private concerns.

I do not wish to disparage any of Mr. Boot's remarks, but I cannot but think that he has not consulted his own balance-sheet for the year ending March, 1902, before writing, for I notice that the capital outlay on mains at Tunbridge Wells was £18,343 10s. 6d., and that the maintenance and public lamps item for the year was £417 19s. 6d., which works out at 2·28 per cent. for repairs, &c., and does not take ultimate renewals into account.

I quite agree with Mr. Boot that a time will come when single-phase working will be the recognised thing, but we must wait until a better single-phase motor is placed on the market, and a good commercial frequency changer.

The Writer of the Article.

I have been very much interested in the discussion that has taken place in the ELECTRICAL REVIEW on the above subject, and I have been very much enlightened thereby. I read the letter by Mr. Boot, Tunbridge Wells, on the same subject; and I should like to know if it would pay to tear up roads to remove disused copper to sell at £30 a ton. Perhaps Mr. Boot thinks that the tearing-up of roads and making good again might be charged to the district rate. However, be that as it may, it is rather a curious argument to raise in support of a depreciation fund. Mr. Boot apparently takes his arguments from the management of municipal undertakings in his own town, which, despite the failure with the municipal telephones, appear to be managed much more upon business lines than at Brighton, as, for instance, they have a certain amount set aside for depreciation. Not only this, but they pay out of the different undertakings about £600 a year towards the establishment charges of the Corporation. At Brighton we have *no* depreciation fund whatever, and although we have over 1½ millions invested in reproductive undertakings, not one penny is paid out of these undertakings towards the support of the establishment charges of the Corporation; but all the salaries of the extra officials who have been engaged, owing to the increase of municipal enterprise, have to be paid for by the ratepayers, who derive no benefit in return. We started our electrical supply in Brighton in 1891. About three or four years ago the Town Council proposed to build a new generating station at Southwick, on which a tremendous lot of money has been spent, notwithstanding the fact that they had a site within the borough much more suitable than the site at Southwick.

At the present time the Corporation are inviting tenders for fitting machinery to the new station at Southwick; they are also inviting tenders for transformer plant for North Road, the present generating station.

Now, Sir, it would be interesting to know what the Council propose to do with the existing plant. Perhaps they are going to sell it at the rate of £30 a ton.

On referring to the return on reproductive undertakings, I find that to the end of March, 1902, Brighton had paid off its electrical undertaking £30,000, out of a capital of £414,000. So it seems to me that, with the exception of a small percentage, the whole of the money invested in the present generating station will be completely thrown away. Perhaps Mr. Boot will be able to enlighten me as to how the depreciation fund is worked in a case like the above, as I dare say there are other cases similar.

Mautby Hill.

Brighton, *June 1st*, 1903.

A "Shocking" Leak.

I am assistant in a large London station, and was called to look at an *engine* which the driver thought had "*gone to earth.*"

On examination I found a jet of dry steam was impinging upon a piece of magnesia lagging, somewhat loosely attached to a steam pipe. This was evidently getting a static charge, and intermittently discharged in a stream of blue sparks on to the steam pipe.

This being unusual and curious, I noted it in the engineer's log at the time, but knew then, and I think it is fairly common knowledge among engineers, that it is quite possible to get a severe shock by putting the hand into a jet of steam when "earthed."

F. W. Ford.

Kingston-on-Thames,
May 29th, 1903.

Shunt Losses in Meters.

Referring to that part of the letter in your paper of May 22nd, signed "R. A.," which says it is a great deal to expect of a meter that its starting current shall be something like $\frac{1}{1000}$th of full load, it seems to me that your correspondent is not familiar with the American alternating current meters now largely in use in that country, in which it is not unusual to find those of the 15-ampere size to have a starting current of ·02 of an ampere or $\frac{1}{750}$th of full load.

W. C. Anderson,
Engineer, Stanley Instrument Co.

Paris.

Electricity in Mining.

The letter by Mr. Croft appearing under the above heading in the current issue of your paper touches many of the vital points at issue in regard to the application of electricity in mines.

I am in full agreement with all Mr. Croft has to say, and think it is a pity that many of the electrical experts giving evidence before the Commission seem to have so little knowledge of the actual conditions met with in collieries.

The only argument that can be given for the use of high pressures is the reduction in first cost of copper for the transmission lines, but if we use high tension transmission underground, and transform down for the motors, the cost of transformers and housing for same is likely to wipe out any saving we may gain in reduced cost of copper. For it must be remembered that even in the largest colliery, the distance in-bye that large motors will be required is limited to, say, 1,000 to 2,000 yds. at the outside. Therefore, the cost of cable bears only a small proportion to the total cost of the plant.

The introduction of transformers adds another link to the chain, and one which may at any time prove the weakest and result in a stoppage of the colliery. Now, anyone acquainted with the working of a coal mine knows that a stoppage of a few hours means a loss in £ s. d. to the company of far greater value than the saving in first cost of copper cables will cover, or the little extra efficiency in transmission would make up in years.

During many years' experience in this class of work, I have found it quite difficult enough to maintain the insulation resistance of motors and switching gear on 500 to 600-volt circuits, and I am convinced that in most collieries in this country the introduction of pressures of 1,000 to 6,000 volts, as suggested by the witnesses referred to by Mr. Croft, would result in most unpleasant experiences.

The electrical experts seem to confuse the conditions met with in the supply of electricity in cities with those in collieries, and to aim at reduction in copper as being the first and most important consideration in connection with the use of electric power. Although I agree that the first cost of a plant is an important point, the reliability and freedom from danger to life is, in colliery work, the vital point to be borne in mind.

With regard to the question of safety, I venture to say that there are few pits where electricity cannot be used on all main roads, as a motor is no more dangerous than a safety lamp, if properly constructed; but there are many collieries where I should hesitate to take even 100-volt motors on to the face. Safety lamps are in these places a sufficient source of danger without adding another. In such mines, I would suggest motor-driven air compressors placed as far in-bye as desirable; these would provide power for

either coal cutting or secondary haulage. Many of the witnesses plump for three-phase motors, but I do not consider there is much to choose between the two as far as safety goes. The chief advantage of polyphase motors is that the slip rings can be more easily encased than a commutator and require a little less careful attention. I say slip rings, because this is the only suitable type of polyphase machine to use for powers over 15 H.P., especially when driving haulage gears. If large squirrel-cage motors are put to drive main and tail haulage gears, the drop in pressure when starting becomes very troublesome, and although auto-starters do overcome a little of this, they are themselves often a source of trouble and often a failure.

It is not rules and regulations we want, as these are likely to hamper the development of electric power, and what may prove very suitable in one colliery will, as likely as not, be quite unsuitable in another. If our colliery people will only go in for first-class plant and materials installed by competent persons experienced in this class of work, and not accept the lowest and often the most undesirable tender, I think there will be little risk either to life or property by the introduction of electricity even in what are termed fiery pits. But if orders are given on cut prices, which generally mean cheap and nasty stuff, I can quite imagine all sorts of dangers and troubles arising even at pressures of 220 volts and under.

W. Angus Scott, A.M.I.C.E.

Cardiff, *May 30th*, 1903.

The Cobdenite Fetish.

In the mass of newspaper articles which I have had to read in the course of the past week, I find constant reference to what the writers are pleased to call the "Cobdenite Fetish" of free trade. As a journalist myself I am loth to deprive any brother craftsman of a phrase which seems to flow so readily from the leader writer's pen. But in fairness to the Club, which I have the honour of serving, I ask your leave to protest against the implied suggestion that the members of the Cobden Club look upon free trade as a matter of faith and not as a matter of reason. On the contrary, they are free traders solely because they have arrived, by process of reasoning, at the conclusion that free trade is the best possible system for the people of this country, and is also the system most likely to secure the permanent unity of the Empire. Their reasoning may be faulty, but they are open to conviction. If the protectionists can prove that it is possible to make this nation more prosperous, either by subsidising one industry at the expense of others, or by taxing everybody for the benefit of everybody else, and if they can further prove that the Empire can be made more loyal by limiting its opportunities of profitable commerce, then the Cobden Club will at once become a protectionist league.

Harold Cox,
Secretary of the Cobden Club.

Gray's Inn, W.C.

To "SUBSCRIBER":—We advise you to write to Mr. W. G. McMillan, the secretary of the Institution of Electrical Engineers, 92, Victoria Street, S.W. He will be pleased to send particulars.—EDS. ELEC. REV.

THE VALUE OF UNITS NOT METERED.

[COMMUNICATED.]

IN selecting the type of meter to be employed, central station engineers have not always given sufficient attention to the following vital considerations:—

1. The accuracy, more especially at low currents.
2. The range of the meter.

Makers of meters which are inherently deficient in the first point have tried to get over the difficulty by diminishing the *range* of the meter, and hence at the present time meters of 2½ amperes, and even down to 1 ampere capacity, are being put on the market.

The author thinks that station engineers will find these very small meters a source of considerable annoyance and expense owing to the necessity of changing the meter for a larger one when the consumer adds a few lamps to his installation or increases the capacity of those already installed (unknown to the supply authority), and also on account of the relatively serious effects of a short circuit on these small meters. The smallest size of main fuse which it pays a supply company to instal is one which melts at 10 amperes, and of course the momentary current due to a short circuit will be very much higher, probably 30 amperes or more.

This points to a 10-ampere meter as the standard at which we should aim as a minimum. The importance of a large range of accuracy is then seen, as this meter should register within 5 per cent. currents of ·1 to ·15 ampere, representing a single 8-C.P. lamp, *i.e.*, a range of nearly 1 to 100.

Probably motor-meters of the mercury bath type are more largely used in England at the present time than any other type, and it may be interesting, in connection with the recent correspondence in your columns, to consider briefly the probable value of the units lost by reason of the under-registration of such meters at light loads.

The following tables show the kind of errors that may be expected, and have been taken from actual tests of motor-meters of the mercury bath type.

Table I. shows some bad cases of inaccuracy of meters, after being out on consumers' premises in all cases for considerably less than two years. The meters were tested before any adjustments were made, with the results given.

TABLE I.

Makers' number.	Size in amperes.	Per cent. accuracy at—			
		10 *a.*	5 *a.*	2½ *a.*	·8 *a.*
54,175	10	98·8	95·2	—	53·8
65,804	10	105·5	95·5	—	74
67,447	10	98·3	97·9	—	79
68,548	10	91·5	82	—	0
68,541	10	97·4	94·7	—	78
63,508	10	93	91	—	0
67,487	10	96	94	—	63
68,925	10	98	94	—	70
49,662	5	—	99·4	96·8	40
69,461	5	—	44	7	0
59,684	5	—	66	29	36

TABLE II.

69,236	5	—	100	106·1	4
69,205	5	—	98·7	91	4
69,004	5	—	99	98	90
67,338	5	—	106	93·9	0
63,226	5	—	101·4	97·3	32
69,975	5	—	99·6	98	94·2
61,936	2½	—	—	101·9	93
61,706	2½	—	—	99·8	30

TABLE III.

Makers' number.	Size.	Per cent. accuracy at currents of—				
		·8 *a.*	·51 *a.*	·34 *a.*	·25 *a.*	·14 *a.*
54,175	10	93	93	88	81	51
64,214	5	96·8	95·5	91·9	84·5	62·5
54,232	5	99·1	96·2	89·2	78·5	45·5
55,544	2½	102·7	100	97	91	71
61,924	2½	98·5	96·9	94·5	90	76·2

Table II. shows some bad cases of inaccuracy in meters as they were received from the makers, and points to the necessity of carefully testing all meters *at different loads* before allowing them to be put on circuit in consumers' premises.

In order to ascertain what low load accuracy could reasonably be attained in this type of meter, five meters were

carefully tested and adjusted so that they were all well within 5 per cent. of perfect accuracy (100 per cent.) at all loads over ·8 ampere. They were then carefully tested at ·5, ·33, ·25, and ·14 ampere. The results are shown in Table III. These meters were much more carefully tested than is usual in commercial practice, and the results cannot be taken to represent the average inaccuracy at small currents; further, it is very doubtful if the accuracy shown would be maintained after being placed on circuit, as meters of this type show a noticeable tendency to slow up.

Taking, as a probable figure in commercial practice, a mean registration of 60 per cent. in the 10-ampere size at a current of ·3 ampere, corresponding to two 8-C.P. or one 16-C.P. lamp, one may estimate the loss to the supply authority as follows:—Assume two 8-C.P., or their equivalent, burn isolated two hours only per day, and taking the average selling price at 3d. per unit, the position will be as shown:—

Units used per annum on 2-lamp load.	Units metered.	Units lost.	Value of lost units.	Value capitalised at 10 per cent.
87·8	52·6	35·2	8s. 9d.	£4 7s. 6d.

The result shows that the value of the lost units would pay 10 per cent. interest and depreciation on £4 7s. 6d. worth of additional plant. But as the difference in cost of a cheap short-range meter compared with an accurate long range one is not likely to exceed £1 7s. 6d. at most, the interest on the balance of £3, or 6s., may be looked upon as clear profit. In addition, maintenance and depreciation on the higher-price meter will probably be considerably less, for reasons previously given.

The above estimate is a very modest one when it is remembered that the single or two-lamp loads are in many small shops, public-houses, or offices practically all-day loads, and the author feels sure that in many instances an average of eight hours per day for six days in the week would not be excessive. In such cases the result would be as follows:—

Units used per annum on 2-lamp load.	Units metered.	Units lost.	Value of lost units.	Value capitalised at 10 per cent.
299	179	120	£1 10s.	£15

or a clear profit of £1 7s. 3d. per annum by using an efficient meter.

It seems, therefore, quite probable that there may be a loss of at least 10s. to £1 per consumer per annum to those central stations using motor-meters on a certain number of consumers, who may represent anything up to 50 per cent. or more of the total number connected, apart from the loss in private house consumers arising from the same causes. As this is a deduction from the net profit, the importance of a wise choice of meters is sufficiently obvious.

REVIEWS.

Electricity as Applied to Mining. By ARNOLD LUPTON, G. D. ASPINALL PARR and HERBERT PERKIN. London: Crosby Lockwood & Son. Price 9s. net.

In this book the authors state that their aim is to present to the reader the leading truths and main principles of electricity and electrical engineering without going into great detail. Their claim for joint authorship is the advantages to be derived from co-operation between the two branches of mining and electrical engineering where mining projects come under consideration. So far as is possible in a work of 270 pages they endeavour to adhere to the task they have set themselves. The examples that have been selected for treatment are of a varied nature, and in many instances of much importance from the mining point of view. There are, however, some departures from the subject as indicated in the title, *e.g.*, at page 141, in dealing with alternating current, the statement is made that the convenience of the two-phase system has led to its adoption by the engineers of the Leeds and Sheffield Corporations.

How far the mining engineer would be justified in taking Corporation work as a standard of comparison is a matter open to question. Again, in dealing with the distribution of energy the *three-wire parallel system* is described. While this system undoubtedly lends itself to the varying needs of a Corporation scheme, it is seldom if ever found existing in mining practice. Electric welding is also mentioned as a possible development about a large colliery, but since this class of work calls for special low voltage generators, there are few, if any, collieries in existence where the reduced cost obtained by such a system would cover interest and depreciation upon plant which would be but ill-suited for ordinary colliery requirements, and as a consequence could not be used for the ordinary run of work with advantage.

The relative importance of the various branches of the subject dealt with might have been better balanced—this may be partly the result of the joint authorship—but it seems rather strange that 19 pages of the text should be devoted to the treatment of primary and secondary cells, while the subjects of pumping and haulage are dealt with in 18 pages and that of coal cutting in 20 pages. This by no means represents their relative importance as far as mining practice is concerned. The chapter upon pumping and haulage, although shortly treated, is distinctly good, but a more concise statement might have been made regarding the conditions under which centrifugal pumps can be used for dealing with heads of water of 150 ft. or over. In dealing with working costs the authors might have stated that at many collieries a certain amount of coal was used for steam purposes which is practically unmarketable (duff from cleaning processes); where such conditions exist the question of economy obviously becomes of much less importance. Some slight repetitions occur at several parts of the book, which are probably the result of joint authorship. All through there seems to be a tendency to magnify the possibility of motors becoming the source of explosions in fiery mines. While it is always desirable to do everything to ensure safety, it ought to be emphasised that the normal condition of the mine should be such that no explosive mixture of gas and air would exist. Outbursts of gas are unavoidable in many cases, but accident to the motor or cables would require to accompany such an outburst before an explosion resulted.

The get-up of the book, with the exception of the few minor points already noted, is upon the whole very good, and a considerable amount of information which will be of great use to mining engineers and colliery managers is contained within its pages. The examples of plant cited are typical of the best practice, and ought to go a long way towards showing the wide field that exists for the application of electricity to mining.

The printing and illustrations are well done, and the book, which was the first of its kind, ought to find a place in the library of all who are interested in the latest developments of this branch of mining engineering.

Handbook of Electrical Machinery and Apparatus of the U.S Sea-coast Defences. By GEO. L. ANDERSON, A.M., Captain U.S. Artillery. London: Crosby Lockwood and Son. 21s. net.

This handbook has been prepared under the direction of the Lieutenant-General commanding the United States Army, and it is specially intended for the use of electricians who have to operate electrical machinery used for sea-coast defences.

The book deals mainly with American-made plant, but the Hornsby-Akroyd oil engines and Schuckert searchlight projectors are very fully described. Much of the information is, of course, common to all kinds of electrical plant, and the book would certainly repay careful study by our own Electrical Engineer Volunteers. It must not be thought, however, that it is only useful to those engaged on sea-coast defences, for, as a matter of fact, it is full of useful little hints as to the erection, care, and management of plant. It should therefore prove useful to all engine, dynamo or switchboard attendants.

The book is divided into sections dealing with Boilers, Engines, Dynamos, Switchboards, Storage Battery, Motors, Hoists, Searchlights, Night Signal Sets, Electric Fuses, &c. There are also special chapters on Telegraphy and Telephony, whilst the last chapter deals with Specifications for Requisitions, Alterations and Repairs.

One of the best chapters in the book is that dealing with Searchlight Projectors, and there is an illustration of the

60-in. Schuckert searchlight at Fort Monroe. With 150 amperes and 60 volts it gives nominally 194,000,000 C.P., and on a clear dark night a person within its beam 12 miles distant can read ordinary print. It will enable a person near the projector to distinguish with the aid of a glass a vessel at 6 miles' distance.

"The probability of a 60-in. projector being hit while in operation at night by an expert marksman on land at ½ mile distance is less than 1 in 50. The danger to projectors from ships' fire from unstable mounts at the usual distance is, therefore, quite small. It will lessen the accuracy of the enemy's shots to extinguish the lamp occasionally, or to move it quickly to some other point. The only special protection which can be given, or will be required, is the same as for all guns—a thick earth parapet reaching to the level of the lower side of the barrel. The largest searchlight constructed has a mirror 6½ ft. in diameter, and an illuminating power of 3×10^9 candles."

The get-there tone about this little book is refreshing, even if the wording is not always grammatical. The electrician is advised that, to be efficient, he must have ambition, intelligence, and the skill gained by careful handling of plant.

"Do not delay work or repairs because exactly what you need is not at hand. Proceed with that which is obtainable and do the best thing possible, so as to avoid making excuses. Even a good excuse is unfortunate. Make timely requisitions for only the necessary and the best stores. Use mineral oil only. Prevention is the rule for machinery troubles, not 'cures.'"

This publication shows the important part which electricity already plays in military operations, and to thinking minds it also indicates much greater possibilities. Battles of the future will be fought and won by the Engineer, and it is a relief to know that whatever faults our own War Office may have, at any rate it has not been slow of late years to appreciate the Electrical Engineer.

Pratique des Essais des Machines Electriques à Courant Continu et Alternatif. By Emile Duquesne and Ulysse Rouviere. Paris: Librairie Polytechnique Ch. Béranger. 1903.

The book which it is our pleasure to review is simply, as indicated by its title, intended for guidance and instruction to those engaged in the testing department of an electrical engineering works. The authors state in their preface: "Lorsqu'un ingénieur aura à essayer une dynamo, un moteur, un transformateur, nous voulons qu'en ouvrant notre livre, il puisse y trouver quelques renseignements utiles pour faire son essai," and this has been their aim throughout—to provide a book which may be used as a reference in the test room for information regarding any test on electrical machinery or apparatus which may be required.

Chapter I. is devoted to a description of their ideal test room and its equipment, arranged so as, according to their ideas, to suit the requirements of such an establishment.

Chapter II. is concerned with laboratory tests, that is, measurements of resistances, ohmmeters, permeability and hysteresis tests, and is well up to date.

Chapter III. deals with tests of direct current generators, resistances of armatures, separation of losses, output, characteristic curves, armature reaction, insulation tests, and specimen sheets are shown for registering complete tests of such machines.

Chapter IV. contains methods of testing direct current motors of the stationary type, while Chapter V. deals with motors for traction purposes.

In Chapter VI. we find various methods given for testing transformers, in which the almost antiquated *three-ammeter* and *three-voltmeter* methods find a prominent place. The wattmeter method is also given with a very neat proof of the correction factor. Methods for the measurement of power in polyphase circuits are also given.

An account is also given of methods of transforming the number of phases in an alternating current circuit.

Chapters VII. and VIII. are respectively devoted to alternators and synchronous motors.

Chapter IX. is a short essay on converters, while induction motors are fully treated of in Chapter X., and practical transformer testing is more fully dealt with in Chapter XI.

We can recommend the book most heartily to those engaged in testing electrical machinery either in an engineering works or in a college laboratory. The book has the advantage of being mainly devoted to testing, and does not suffer from the drawback of practical applications being lost in a maze of theory.

Specifications for a Lancashire Boiler. By "Inspector." Manchester: The Technical Publishing Co.

The makers of water-tube boilers have been so insistent upon their superior safety and on the inability of shell boilers to stand high pressures, that the steady increase of shell boiler pressures up to 200 lbs. and even 250 lbs. must have been a little disconcerting to them. The specifications before us have been brought up to date, and are made out for the standard 8-ft. Lancashire boiler. The last issued specification of the Lancashire boiler by the same publishers was for the 7 ft. 6 in. boiler at 100 lbs. pressure. Only a few years ago the 7-ft. boiler at 100 lbs. was looked on as the best modern practice. Now we find the 8-ft. boiler for 200 lbs., with its shell of a single plate per ring, and $\frac{15}{16}$ in. thick.

The Adamson furnace joint still maintains its position as the tube joint *par excellence*. Cross tubes are referred to as needless for strength, but are mistakenly, as we think, credited with helping circulation. These cross tubes are veritable flame extinguishers, have been proved of no use in circulation, and ought never to be employed. The somewhat unscientific gusset-stayed end-plates live on, and have been well adapted to the onerous conditions of the modern boiler. The longitudinal bolt stay is relegated to the scrap heap as unnecessary, and, it might be added, liable to cause stresses and grooving. Planed plate edges at 75° are to be fullered to an angle of 85°.

A 30-ft. boiler is to have seven rings of shell-plating, the first one being an outside plate and the lay parallel. Front end plates are still preferred attached by angle iron to the shell, the back end plate being flanged inside the shell plate, and the back ends of the flue tubes being reduced from 38 in. to 32 in. to allow of equal elasticity of the back plate. Full particulars of gusset spacing and other leading dimensions are given. The test pressure is 300 lbs., and the maker is precluded from putting on more than 150 lbs. as a preliminary test. A very excellent clause this is to enable the end-plate gauging tests to be of full value, but how is the maker to be kept from doing this? Well made by the best makers, the Lancashire boiler is good and safe, but we regret that there are makers who will not hesitate to use other than the best materials for certain parts. For example, so-called steel alloy, which is little else but malleable cast-iron, is used for manhole mouthpieces. This substance has no extension under fracture by tension, and is a dangerous and treacherous material. The setting of the boiler is illustrated very fully.

The manufacture of boilers is now a piece of high-class and accurate mechanical work, and the art has made steady and continuous progress ever since the year 1854, when the first boiler inspection was undertaken under the auspices of the late Sir William Fairbairn.

THE DESIGN OF INDUCTION COILS.

A valuable article on the induction coil, by Dr. James Edmund Ives, will be found in the *Electrical World and Engineer*, N.Y., March 28th, p. 513. We summarise the principal points.

The use of a condenser in the primary circuit is to prevent excessive sparking at the break. There is a best capacity of condenser for each coil, and even for each different current with the same coil. Condensers should therefore be made so that the capacity can be readily adjusted to give the longest spark in the secondary.

Klingelfuss (see *Annalen der Physik*, Vol. 5, pp. 837—871, 1901) has shown that for coils giving sparks of all lengths up to 100 cm. :—

1. The secondary spark length is directly proportional to the number of secondary windings.

2. The primary induced E.M.F. is proportional to the primary current.

3. The secondary induced E.M.F. is also proportional to the primary current.

The maximum difference of potential, v_2, in the secondary, determining the length of the secondary spark is given by the equation,

$$v_2 = i_0 \sqrt{\frac{L_2}{C_1}}, \qquad (1)$$

where i_0 is the primary current, L_2 the inductance of the secondary coil, and C_1 the capacity of the condenser.

It is found that for induction coils the formula for the transformer holds approximately, namely,

$$\frac{v_2}{v_1} = \frac{n_2}{n_1}, \qquad (2)$$

where n_2 and n_1 are the number of turns in the secondary and primary circuits respectively.

Dr. Ives found that coils with horse-shoe cores gave longer sparks for the same number of turns than coils with straight cores, but it was found practically impossible to construct such coils for long sparks, as the sparks jump from the coils across the air-gap.

He also found that coils with straight cores gave longer sparks when the cross-section of the core was larger in proportion to the length. For example, a coil in which the ratio of a side of the cross-section to the length of the core was 1 : 12, gave a spark 25 per cent. longer than a coil in which the ratio was 1 : 20. In his experiments he used a mercury break, in which the breaking pole was an amalgamated copper wire dipped in and out by hand. The mercury was covered with a layer of petroleum. He found this form of break to be the most effective. A coil of a relatively small number of turns, when properly constructed, can be made to give very long sparks. Dr. Ives obtained sparks 100 cm. long with only about 85,000 turns. To achieve this, the secondary must be well insulated, the most efficient form of break must be used, and the condenser around the break must be variable, so that the capacity can be adjusted to that most suitable. In a paper in the *Physical Review*, Vol. 14, 1902, Dr. Ives has given the dimensions and the corresponding inductances and resistances of a number of secondary coils.

The best form of induction coil appears to be the straight form with a long core projecting 3 or 4 in. beyond the secondary. The object of this arrangement is to economise the secondary wire, since the number of lines of force cutting a turn of the secondary is greater at the middle of the primary than it is at the ends.

Various rules have been given for the length of wire required to produce a spark of a given length, but such rules mean very little, since the secondary difference of potential depends on the diameter of the secondary wire, the character of the core, and the conditions prevailing at the break. The only way to obtain definite knowledge of a coil appears to be to measure the inductance of the secondary, then by means of equation (1) the maximum potential difference can be calculated.

MUNICIPAL TRADING.

The advocates of municipal trading are to be congratulated upon one thing; they never lose a chance of promoting their cause, and at the same time discrediting, as far as possible, the views of those who happen to be opposed to them. Upon the motion which was put on May 27th for the appointment of certain members of the House of Commons as representatives of the Lower House on the Joint Committee, Sir Albert Rollit took occasion to re-assert his objections to the appointment of any committee. He said :—"I distrust the necessity for this committee and the advantage likely to arise from its work. The prospect, probably the intentional prospect, and the ultimate result, will be the placing of some restriction on that municipal action which has taken place with such great advantage to the country." We may remark, in passing, that for our part we should be very glad to see some restriction placed upon the municipal traders whose methods have been only too often commented on in these columns. Sir Albert continued :—"Local government, dependent on local experience and knowledge, would become gradually better if it were placed under no restrictions whatever, because the very essence of local government is variety of experience."

It is difficult to deal with this extraordinary argument with any seriousness. What proof have local authorities given that they invariably do everything which they undertake entirely to the public advantage? A private company, if it fails in an enterprise, makes its next public appearance in the Winding-up Court; a local authority, on the other hand, which purports to carry on "business" at a profit, is always able to show a favourable balance-sheet; for, as soon as there is a deficit, the cry is heard—"Oh! that was caused by expenditure for the public good." In our view, the craze for the municipalisation of everything would disappear if the pretence that electric lighting systems, tramways, &c., are carried on to the relief of rates were fully exposed. The opposition of municipal traders to the appointment of a committee is based, as we believe, upon a fear that municipal trading may even at this late stage be examined and found wanting. For our part, we certainly have no fear of the salutary result of the deliberations of the committee.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending June 3rd, 1902.		Week ending June 2nd, 1903.	
Adelaide	Value £594	Alexandria	Value £16
Amsterdam	22	Amsterdam	724
Azores. Teleg. instruments ..	150	Antwerp. Elec. fuses	303
Biera. Teleg. mat.	241	Bombay	328
Bombay. Teleg. instruments ..	550	Brussels	45
Calcutta	726	Buenos Ayres	413
,, Teleg. wire	8,635	Calcutta	929
Cape Town	15	Cape Town	24
Channel Islands	105	Copenhagen	209
Colombo	49	Delagoa Bay	667
,, Teleg. mat. ..	32	Durban	544
Copenhagen. Teleg. wire ..	11	,, Teleg. mat.	740
Corfu Teleg. mat.	47	Fremantle	39
Durban	2,113	Halifax	190
Fremantle	319	Hamburg. Teleg. mat.	440
Gibraltar. Teleg. mat.	184	Hong Kong	21
Halifax	40	La Plata. Teleg. mat.	119
Lyttleton	51	Marseilles	25
Madras	50	Melbourne	126
Maryborough	87	,, Teleg. mat. ..	25
Melbourne	650	New York	13
Nagasaki	636	North Atlantic. Teleg. cable. .	26,000
Port Elizabeth	104	Odessa	169
Port Said	37	Oporto	30
Rockhampton	51	Penang	2,600
St. Petersburg. Teleg. cable ..	69	Perth	28
Shanghai	228	Port Elizabeth	291
Singapore	81	Shanghai	10
Sydney	122	Singapore	69
Vera Cruz	4,796	Sydney	1,064
Wellington	90	Wellington	101
		Yokohama	103
Total ..	£20,877	Total ..	£36,400

Foreign Goods Transhipped.

Gothenburg. Elec. appar.	Value £40	Durban. Elec. lamps. ..	Value £86
Sydney. Elec. lamps	120		
Total	£160		

American Patents.—From Messrs. Jules Géraud, Leclerc & Co., patent agents, of Rio de Janeiro, we have received a small book of some 60 pp., giving information respecting the procedure necessary in obtaining patents and marks in all Republics of Latin America.

E.P.S. Batteries.—The Electrical Power Storage Co. has received contracts for storage batteries from the following:—Londonderry Corporation, to the specification of Messrs. Preece and Cardew; Darlington Corporation, to the specification of Messrs. Kennedy & Jenkin; Faversham Corporation, to the specification of Messrs. Hopkinson & Talbot.

Books Received.—Report of speech on "Municipal Trading," by Sir Albert Rollit, President of the Association of Municipal Corporations. London: *Councillor and Guardian*. 3d.

"A Treatise on Electro-magnetic Phenomena and the Deviations of the Compass," by Commander T. A. Lyons. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

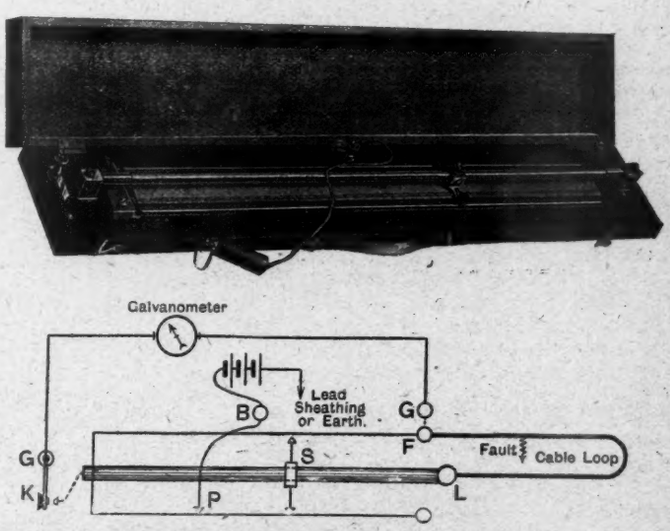
"Construktion und Prufung der Elektricitätszahler," by A. Konigswerther. Hanover: Verlag von Gebruder Janecke.

Regina Arc Lamps.—The enclosed arc lamp of the Regina Bogenlampenfabrik, it is claimed, is specially noteworthy on the score of its strong and simple construction, the long period of burning without attention, and the uniform distribution of the light. The long burning is largely due to the completeness with which the arc is enclosed, so that when the oxygen within the globe is consumed it is not readily replaced. In the direct-current lamp the consumption of carbon is ·71 mm. per hour of the positive, and ·15 mm. of the negative, the duration of burning with one

The Regina Arc Lamp for Indirect Lighting.

trimming being 200 hours, and the inefficiency less than 1¼ watts per candle. The lamps can be used singly on any voltage from 100 to 300 volts, or in series; about 350 of them were used for lighting the Düsseldorf Exhibition last year. Besides the direct-current enclosed type, alternating-current lamps and lamps for a variety of purposes, such as photography, surgery, &c., are made. The accompanying illustration shows the Regina lamp used for indirect lighting, the rays being thrown direct, and also reflected from an opal screen, upon the ceiling, whence they are diffused.

Fault Localising Bridge.—A simple portable instrument for the localisation of faults on electric light and power mains has been brought out by Messrs. Nalder Bros. & Co., of Queen Anne's Gate, S.W. It is based on Mr. F. C. Raphael's principle, and gives a direct reading of the distance of the fault from the station by a simple balancing test. The test is independent of the resistance of the cables, which is often not known with accuracy, and by its means a fault of appreciable resistance may be localised, as well as a dead earth or short circuit. The connections are as shown in the accompanying diagram, the faulty cable being connected to terminal F, and a sound one to complete the loop to terminal L. In making the test, the sliding jockey S is set to the length of the cable loop. The position of the portable jockey P at which balance is obtained is then found by pressing down this jockey key at different positions on the wire, and tapping the galvanometer key K. When no deflection is obtained on depressing K the position of balance is obtained. The reading opposite the portable jockey at the balance position is then the distance of the fault from the terminal F. If the cables are not of the same cross-sectional area, or if they cannot be connected directly to the instrument, suitable allowances must be made for the "equivalent lengths" of the cables and leads. The instrument, though involving no new principle, is of practical and convenient form, and will doubtless be of considerable utility to mains superintendents.



G, Galvanometer terminals; B, Battery terminal; K, Galvanometer key S, Sliding jockey; P, Portable jockey.

Raphael Fault Localising Bridge.

Calcium Carbide.—A meeting has just been held in Nuremburg, Germany, between representatives of the Hafslund Carbidfabrik, Hafslund, Norway, the Bosnian Electrical Co., of Vienna, and the Lonza Electrical Co., of Genoa, when it was decided to form a "Syndicate for Electro-Chemical Industry." The new concern is intended to acquire and develop new electro-chemical processes, and in connection with this object a testing laboratory, under the charge of Dr. P. Askenasy, is to be established in Nuremburg (54, Gugelstrasse).

Trade Announcements.—Messrs. Hickie, Borman and Co., of 22, Billiter Street, E.C., have been appointed sole agents in the United Kingdom for the Dürener Metallwerke Act. Ges. of Duren, Rheinland, whose special manufactures include copper wire for electric and telegraph purposes, commutator copper, copper bars, stampings and forgings, white metal for bearings, &c.

Messrs. Mason & Gibbs, of Nottingham, have dissolved partnership. Mr. Mason will carry on the business at Nottingham, and Mr. Gibbs takes over the Mansfield business, viz., the Central Electric Light and Power Co.

Catalogues and Lists.—The Union Electric Co., Ltd., have placed before us advance copies of their price lists of standard and precision amperemeters and voltmeters. These two lists are the first sections of a comprehensive list which is now in the press. The complete catalogue, when published, will contain illustrations, particulars and prices of milliamperemeters, portable and combined testing ampere and voltmeters, single or twin, tram-car, launch and automobile instruments, ohmmeters, &c., in all sizes and of all ranges. A large stock of ordinary ranges is kept in London, and the finished parts for assembling all others are held ready in the factory stores.

A new bell catalogue (No. 166) has been published by Messrs. Falk, Stadelmann & Co. Ltd., of Farringdon Road, E.C. It contains particulars and prices, and some hundreds of illustrations of a great variety of electrical bell apparatus and accessories, contacts, pushes, batteries, indicators, bells, &c.; also tools for wiremen's use. A good deal of electro-medical apparatus and some model motors and dynamos are included.

The General Electric Co. (1900), Ltd., has brought out a new list of various styles of "Freezor" electric fans for desk, bracket and ceiling positions. We had some summer weather a few days ago which turned the fancy of many a busy man in the direction of these welcome devices. It is true that a temperature fall of 20° or 30° has been experienced since, but that is only intended to be brief, and for the accommodation of the G.E. Co. and other fan-makers who have a big demand to meet. No doubt there will be a rush for "Freezors" directly.

An illustrated sheet has been issued by Messrs. James Dawson and Son, Ltd., of Boultham Leather Works, Lincoln, showing some views of the different departments of their manufactories where stretched leather belting, link and Balata beltings, &c., are made.

The New British Arc Lamp Co., Ltd., of Horsell Road Works, Holloway Road, N., has sent us a copy of its illustrated price list, No. 2, showing its "Arcazon" patent long-burning arc lamp for continuous and alternating-current circuits.

The proprietor of *Phillips's Machinery Register* has sent us a specimen copy of his "Electrical and Autocar Supplement," in which he gives details of a great deal of new and second-hand machinery which is for sale.

For Sale.—The Halifax Corporation is offering for sale a 475-I.H.P. vertical engine and 300-KW. single-phase alternator. See our advertisement pages to-day.

The electrical plant at Brixton Theatre is for sale. Particulars will be found among our advertisements to-day.

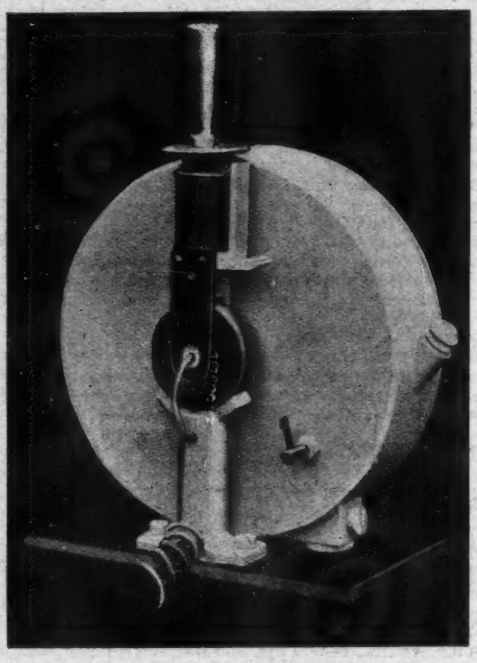
Aron Meters.—It appears that for some years past the Physikalisch Technische Reichsanstalt, in Germany, has been conducting tests on electricity meters with a view to determining on behalf of the Government which particular types are fit to receive official certification at the hands of the various testing authorities in Germany. The trials have been most exhaustive, and embraced tests not only for accuracy, but for reliability and durability in use. The Aron meter enjoys the distinction of being the first type to be passed for both direct and alternating currents, single and polyphase. The official announcement appears in the *Electrotechnische Zeitschrift*, 1903, part 20:—

In accordance with Section 10 of the law of June 1st, 1898, respecting electrical units, the testing authorities throughout the German Empire can now give certificates for the following types of electrical measuring apparatus:—

1. Reversing meter for direct current, types K and L, made at the electricity meter factory of H. Aron, in Charlottenburg.
2. Reversing meter for single and polyphase alternating current, types P and N, made at the electricity meter factory of H. Aron, in Charlottenburg.

France.—The report of the Compagnie Continentale Edison for last year shows a net profit of £41,896.

Woolliscroft's Safety Enclosed Starting Switch.—An ingenious and novel motor starter has been devised by Mr. Woolliscroft, of the Sandycroft Foundry Co., Ltd., Chester, and is being manufactured by that firm. It consists of a watertight cast-iron drum, partially filled with soda and water, and fitted with external contacts and terminals, and internal electrodes. The drum is carried on insulating bearings, and is provided with an aperture



Woolliscroft Motor-Starting Switch.

for introducing the liquid, covered by a screwed plug, which also acts as a relief valve for the gas generated in electrolysis; this aperture is never submerged, and therefore cannot leak. The connections are best shown by means of the diagram given below. A "minimum" release and retaining coil, in series with the shunt winding of the motor, is carried on a lever which forms a handle rotating on the same axis as the drum; when this is energised it brings a catch into gear with a trigger on the drum, which is then rotated by means of the handle, causing the drum to revolve and the electrodes to dip into the liquid, gradually cutting out the resistance of the latter in the main circuit. At the extreme end of

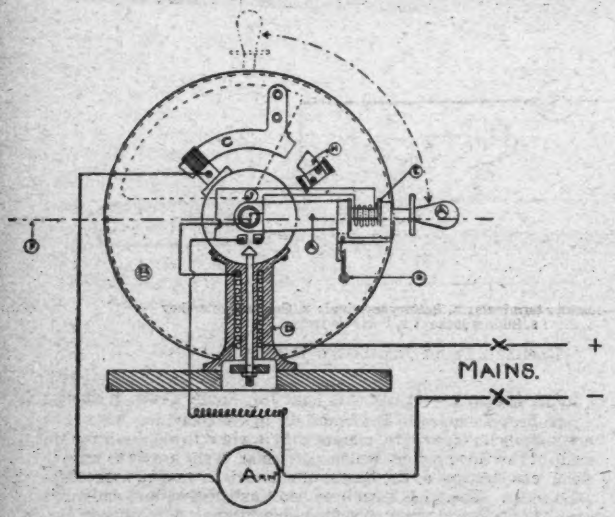


Diagram of Connections.

the travel of the drum the resistance is finally short-circuited by means of a special contact; at the same time the handle is held up by a catch. A "maximum" release coil is enclosed in one of the cast-iron bearings, which, in the event of an excessive current passing, during the act of switching-on, or whilst running, short-circuits the minimum coil and allows the drum to return by gravitation to the off position. The obvious advantages of this device are simplicity and safety; overheating, sparking, irregular steps, &c., are completely abolished, and the usual precautions against starting the motor too quickly, switching on the armature before the field is excited, leaving the resistance cut out in case of a failure of the supply, excessive overloading, &c., are all embodied in the apparatus. The motor should be stopped by turning off the main switch, when the shunt will remain closed on the armature and will hold up the starter until the E.M.F. dies down. The resistance is suitable for any voltage up to 700 volts, the density of the electrolyte being varied accordingly, and it cannot be burnt out. It seems to be a thoroughly practical and useful device, and, we understand, has already gained considerable favour amongst users.

New Oil Can.—Messrs. Joseph Kaye & Sons, Ltd., of Lock Works, Leeds, and London, are now introducing their patent serrated oil can, which is made on a new system, whereby the seams or joints of all vessels made of sheet metal may be more securely soldered or brazed than by the old method, where a plain cut edge or rim has to be made water or oil tight. The serrated edge, as shown in the figure, not only accomplishes this object, but the top or lid of the can may be soldered within the vessel, adding considerable strength and stability to the life of the can. For more than 30 years Messrs. Kaye have been to the front in this line, and their most recent improvement, viz., their patent slide feedhole, is shown in figs. 1 and 2; the improvement consists in operating the feedhole automatically, as it were, by the simple opening and closing of a hinged lid or cover, the latter being ingeniously linked to their original slide, which has also the

Fig. 1.

Fig. 2.

advantage of keeping the feedhole perfectly clean, but whether the oil can is fitted with their feedhole or no, should any dust or fluff by any possible chance get into the can, it is impossible for the spout to become choked or stopped up, as every oil can supplied by Messrs. Kaye has a self-contained filter through which the oil must pass before passing through the valve into the spout, and, needless to say, such provision is invaluable for all machinery having bearings to be lubricated whether delicate or otherwise. We understand that Messrs. Kaye before introducing these improvements to the public, determined to have a new and complete range in eight sizes, rising from ½ pint to the formidable 2-pint oil can, hence it has taken some years to put them on the market on account of the special and numerous combination tools required for all the parts.

Arc Lighting in India.—We have received from Messrs. Johnson & Phillips, of Old Charlton, a photograph of the Kashmir Camp at the recent Delhi Durbar, showing their "ARK" lamps in position. There were altogether 70 of these enclosed long-burning lamps used for lighting the camp; they were arranged two in series on a 225-volt direct-current circuit. They were supplied through the makers' Indian agents, Messrs. Balmer Lawrie, of Clive Street, Calcutta. The lamps are similar to those supplied for lighting the Boer prisoners' camp, and for the lighting circuit on the new electric tramways recently inaugurated in Calcutta.

Liquidation.—A meeting of the British Electric Street Tramways, Ltd., will be held at Granville House, Arundel Street, W.C., on June 30th, to hear an account of the winding-up from the liquidators, Messrs. R. Goodman and E. C. Parford.

ELECTRIC LIGHT AND POWER NOTES.

Aberdeen.—At a meeting of the T.C. a recommendation of the Gas and Electric Lighting Committee to extend the present cable subway in Crown Street westwards to Holburn Street was agreed to. The estimated cost was stated to be £6,700.

Ayr.—The earthing of one of the Corporation lighting mains at Tam's Bridge, Ayr, caused some excitement on 29th ult., several men, boys and horses being brought down by shocks. The "earth" was caused by a pickaxe, it is presumed, the roadway having recently been relaid.

The light having gone out mysteriously at the Market recently, it was found on examination that a rat had short-circuited one of the transformers. It was found translated between the frame and one of the live terminals.

Barking.—The report on the past year's working of the electricity undertaking, states that the net result is neither a loss or profit of a few pounds. The revenue shows an increase of £1,000.

Basingstoke.—The Corporation has, subject to a satisfactory guarantee being forthcoming, and to the approval of the Board of Trade and of the Local Government Board, accepted the tender of the National Electric Wiring Co. for a lease of their electric lighting order of 1899. Briefly, the terms are that the Corporation shall raise the loan and the company erect the works and provide the machinery under the supervision of the Council's engineer. That they shall charge the Council a commission of 10 per cent. on the accepted tender for the buildings, &c., and pay the Council 6½ per cent. per annum to cover the cost of repayment of principal and interest on the loan for capital expenditure, which shall include the cost of obtaining the order and other incidental expenses. The Council have the option of taking over the undertaking at the end of seven years by paying the company a premium of 9 per cent. on the total outlay, or at the end of 14 or 21 years without premium, by giving one year's notice of their intention to do so. The company undertake to supply electricity to private consumers for lighting at 5d. per unit, with the alternative of the first two hours at 6d. and 22 hours at 1½d., and for power 3d. per unit for the first two hours and 1½d. per hour for the other 22. They offer to do the public lighting at 2½d. a unit, and to supply the Corporation with energy for pumping water and sewage at nine-tenths of a penny per unit. They further agree to erect a destructor as part of the scheme, and to charge the Council 2s. per ton for consuming refuse, and to credit them with the value of the steam thus produced. They will run the undertaking in the name of the Corporation. Mr. Reginald P. Wilson has been retained by the Council as consulting, and practically as resident, engineer.

Berwick.—The principal streets of the borough are to be lit by electricity supplied by the Urban Electric Lighting Co.

Blaydon.—The owners of the Priestman Collieries are erecting improved coke ovens to produce 200,000 tons of coke per annum. The usual bye-products will be secured, and in addition a large quantity of coal gas, which will be utilised in an electrical generating plant (by the Priestman Power Co.) and the energy distributed for industrial purposes in the Tyne district.

Bradford.—The Electricity Committee has decided to reduce the charge of electricity for private lighting from 4½d. per unit to 4d., and to increase the charge to the Tramways Committee from 1d. to 1½d. per unit. The latter decision will be opposed when it comes before the Council for adoption, by the Tramways Committee, as it means an increased expenditure to them of £3,000 a year.

Bury (Lancs.).—The Governors of the Grammar School have decided to have the new buildings installed with the electric light.

Chorley.—The T.C. on May 29th received from the E.L. Committee a recommendation that Messrs. Lacey & Son should carry out the E.L. Order, 1898, at an estimated cost of £18,404. There was considerable opposition, and it was decided to refer the matter back for further consideration.

Dalkeith.—Permission has been granted to the Electric Supply Corporation, Ltd., London, to erect an electric generating station in Croft Street. This corporation will carry through the arrangements made with Messrs. Crompton & Co. for the electric lighting of the streets of the burgh, and will also undertake private lighting.

Dumfries Electric Lighting Scheme.—At a recent meeting of the Electric Lighting Committee, it was resolved to recommend the Town Council to accept the offer by Messrs. Suter & Co., London, to carry through the electrical installation. The Council are to provide the capital and the company to erect the works on a site leased to them, and to pay to the Council annually the amount required for interest and sinking fund. Any profits earned after meeting that liability are to be equally divided between the Council and the company. The company takes the risk of any loss; but any loss which may be incurred in one year is to be set against the profits of future years. The Council is to be entitled to take over the undertaking without payment at any time on giving a year's notice. The maximum charges are to be fixed at 5½d. per unit for private lighting, and 2½d. for public lighting and power.

Dundee.—The total income of the electrical department during the year was £24,041, as against £16,529 last year. There has been received for private lighting £12,600, as compared with £11,045 last year. Private motors and public lamps remain much as before, while the income from the tramways has risen from £5,870 to £9,860. After paying the year's expenses, there is a credit balance of £212, which is slightly less than last year.

Edmonton.—The schemes of Mr. R. Hammond and Mr. W. C. Hawtayne for the establishment of an electrical undertaking in accordance with the recently obtained provisional order, came before the District Council on Tuesday night, when, after considerable discussion, they were referred to a committee, directions being given for the experts to be invited to attend and explain the reports. An attempt was made to defer the matter until next March, and was defeated by only one vote. It was urged that the experts had considerably over-estimated the number of probable customers.

Exeter.—The City Council had a protracted discussion on the 27th ult. on a proposal to instal mechanical stokers at their new electricity generating station, now in course of erection. Babcock & Wilcox stokers were recommended, the cost for six boilers being estimated at £1,700. Eventually the Council referred the question back to committee.

Gillingham (Kent).—The U.D.C. has fixed the price of electricity for power at 6d. per unit for one hour per day maximum demand, and 1d. per unit afterwards. For places of worship a flat rate of 5d. per unit has been adopted. The Council has decided to borrow £10,000 from the Prudential Assurance Co. for electric lighting purposes in accordance with the sanction of the Local Government Board.

Gravesend.—The District Council proposes to hold an electrical exhibition in the Town Hall next September, with the object of securing customers. Negotiations to acquire land for extending the electrical works are pending.

The T.C. has opened negotiations with the Brush Electrical Engineering Co. with the object of securing motors for consumers.

A scale of discounts has been adopted by the T.C. as follows:—Quarterly accounts exceeding £10, 2½ per cent.; exceeding £50, 5 per cent.; exceeding £100, 10 per cent.

Glasgow.—Councillors Kennedy and Wm. Mackay, along with Mr. Chamen, chief engineer, have been appointed representatives of the electricity department of the T.C. to attend the annual meeting of the Municipal Electrical Association at Sunderland in July.

Handsworth.—At the meeting of the U.D.C. on May 28th, it was moved that the Committee should be instructed to at once carry out the Council's obligations under the electric supply order, 1899. This was agreed, and it was decided to apply for a loan of £3,136 in connection with the proposed electric lighting station.

Heckmondwike.—The report on the first year's working of the U.D.C.'s electricity undertaking shows that the gross profit was £443. After providing for interest and sinking fund, there is a loss of £476 13s. 10d.

Holyhead.—A L.G.B. inquiry into the application of the U.D.C. for loans of £12,700 for electric lighting purposes, and £3,300 for the provision of a refuse destructor, was held on May 27th, and there was opposition on behalf of the gas company, the railway company, and Lord Stanley as ratepayers.

Hoylake and West Kirby.—The U.D.C. has decided to apply to the L.G.B. for a loan of £5,500 for E.L. purposes.

Hull.—The result of the past year's work of the Electricity Department shows that, after providing £14,283 for financial charges and depreciation, a net profit of £1,524 remains. The output has increased from 1,490,099 units in 1902 to 2,385,577 units in 1903—an increase of 60 per cent.

King's Lynn.—The annual report on the Corporation electricity undertaking shows a deficit of £47 1s. 2d., against £793 5s. 7d. last year. The works cost was 1·457d. per unit.

London.—SOUTHWARK.—Unsuccessful municipal trading was discussed for several hours by the Borough Council last week on the consideration of an adjourned report from a special committee appointed to inquire into the administration of the electric light undertaking. A summary of this report and its recommendations appeared in the ELECTRICAL REVIEW of May 22nd. The Mayor, in moving, as chairman of the committee, the adoption of the report, explained that he did not agree with all its recommendations. At present 33 per cent. of the plant was idle. The chairman of the Electric Lighting Committee commented on the lack of support which the Council gave to the undertaking. In spite of gloomy anticipations, he believed that at the end of 42 years the municipality would have a good business worth at least £150,000. Mr. Attenborough said if they were to have municipal trading, the trading should be done in a business-like way. The electric light undertaking was casting a burden of over £1,000 a year on the rates, and still, in spite of this, the side streets were disgracefully lit. Other councillors deplored the "muddling" of the Electric Light Committee and their unbusinesslike ways. Finally, the recommendations of the Special Committee were put *seriatim* and were all negatived except the last, which was: "That the reference be discharged."

HACKNEY.—Up to date there are, according to the report of the Electric Lighting Committee of the Borough Council, 91,955 8-C.P. (30-watt) lamps connected to the mains, and 5,082 applied for, and awaiting connection. The total exceeds the connections for which the existing plant was put down by 2,037 8-C.P. (30-watt) lamps.

STEPNEY.—The Borough Council on Wednesday gave directions to hasten the lighting of Upper East Smithfield by electricity. The contract with the New Century Arc Light Co., Ltd., to supply and erect arc lamps and columns for certain thoroughfares was extended to other streets.

BATTERSEA.—On Wednesday it was resolved to extend the electric mains at an estimated cost of £926.

Lytham.—The U.D.C.'s E.L. order, which should have expired in June, has been extended for a year.

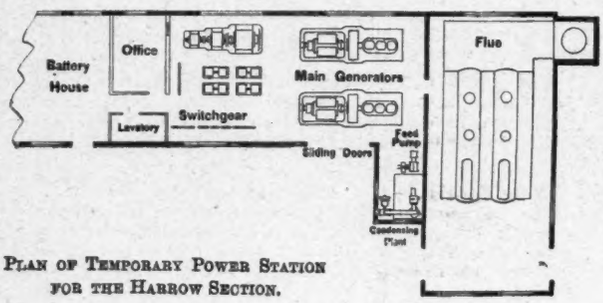
Mexico.—The Mexican Government has approved the Bill granting a concession to the Mexican Light and Power Co., Ltd., to utilise the water power of the Rivers Tenango, Manso and Quepuatla, in the district of Huauchinango.

(Continued on page 982.)

THE ELECTRIFICATION OF THE UNDERGROUND.

By WILFRED YORKE.

Incorporated in 1864, and finally finished in 1884, the Metropolitan District Railway has grown old while still a youth, and of late years much mud has been thrown at it. As long as three years ago some of it stuck, when an experimental electrical train was run between High Street, Kensington, and Earl's Court. Although a complete success, nothing



Plan of Temporary Power Station for the Harrow Section.

came of this, for the directors were fearful of raising the necessary capital, and it was only when Mr. Chas. T. Yerkes, the American street railway king, came along with the requisite dollars that a decision was arrived at.

The Metropolitan District Electric Traction Co., Ltd., was promptly formed by Mr. Yerkes; but as one after another of various tubes authorised by Parliament for construction (and latterly the London United Tramways) was bought up, this name was thought to be inadequate, and was replaced by that of the Underground Electric Railways Co. of London, Ltd.

The primary object of this company—*i.e.*, the electrification of the District—reached its initial stage of completion on April 17th last, when the first electrical train was run over the North Ealing to South Harrow section; and as this portion will shortly be opened for traffic, the subjoined description may prove interesting to the readers of this journal.

A glance at a map shows the section running from Mill Hill Park to South Harrow. It embraces six stations, while a seventh is now in course of erection in close proximity to the new Royal Agricultural Show Ground, for the purpose of setting down the numerous visitors whom this exhibition is likely to attract. The line, which is double track and about five miles long, lies throughout in the open. Though built some time ago for ordinary running, it was never used, and when the project of electrification was promulgated it was decided to commence with this part, and use it for experimental purposes.

The small generating plant built for the experimental trials between High Street, Kensington, and Earl's Court has been enlarged and removed to Alperton, a point midway between Mill Hill Park and South Harrow stations. It has been installed close by the track on the bank of the Grand Junction Canal, from which the necessary water for the boilers, &c., is drawn.

The plant consists of two 400-H.P. Belliss-Siemens sets, fed by two Babcock & Wilcox boilers. The engines can be run either condensing or non-condensing. A view of the engine room is shown on page 966.

At Alperton this plant will be called upon to do very much more than it did at Earl's Court, and a "Highfield" booster, in conjunction with a 400-ampere-hour battery, has therefore been installed to assist the main machines over the peaks. The remainder of the floor space of the engine room is occupied by four 6-KW. motor-generators (550 volts to 110 volts) for use in the automatic electro-pneumatic signalling. Space does not permit of its description here. Suffice it to say that as a half-minute service has been run continuously in the States on this system, no qualms need be entertained as to its practicability.

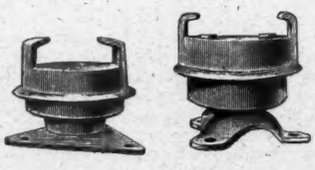
The current is fed into the conductor rails at a point opposite the power house by means of overhead conductors. This is the more convenient, as the track is on a level with the roof of the building.

The permanent way stretches, at present, as far as South Harrow, whence it is rapidly being pushed down as far as Uxbridge. A link will also be formed between this line and the Metropolitan Railway's branch, permitting an interchange of traffic. One of the most notable pieces of permanent way construction is a magnificent viaduct now in course of erection over Roxeth Valley.

The conductor rails are of the Vignoles pattern, weighing 100 lbs. per yard. The positive is laid outside the running rails, and the negative between them; both conductor rails are supported at intervals of about 12 ft. by a similar type of insulator to that employed on the Milan-Varese-Porto Ceresio Railway, the insulating material being artificial granite. The conductor rails are not secured to these insulators, but rest between two projections which permit of a certain amount of longitudinal and vertical movement. One of the illustrations shows positive and negative insulators. The collecting surface of the positive conductor rail stands 3 in. higher than the surface of the running rails, while the surface of the negative is $1\frac{1}{2}$ in. above the latter. Protection planks are placed on either side of the positive rail to prevent accidental "shorting," the bolts securing these being insulated from the rail by fibre bushes. It has already been found, however, that two protection planks are unnecessary, and therefore on the rest of the company's system only one is to be used, placed between the positive conductor and the running rails. Neptune bonds and fish-plates are used throughout. At level crossings and crossing points, both conductor rails are interrupted, continuity being preserved by means of underground linking cables of $1\frac{1}{4}$ sq. in. section of copper. One of the figures shows the conductor rails and insulators, and the protection planks on the positive rail. The negative rail is *not* insulated as is popularly supposed, but is permanently earthed to the running rails through the automatic signalling.

Between the two sets of running rails, or in the "six-foot" as it is more commonly called, a spacious conduit has been laid. All feeders and wires are being drawn into this, including the three-core lead-sheathed extra high-pressure feeders from the Chelsea power house running as far as Sudbury Hill, where a sub-station is now being erected, which, when finished, will displace the temporary station at Alperton. All signal feeders, telephone wires, &c., are also laid in this duct.

Two "sample" trains built by the Brush Electrical Engineering Co., of Loughborough, are at present making a series of trials over the line. The trains differ only in the system



Negative and Positive Insulators.

of control, one being fitted with the Westinghouse, and the other with the British Thomson-Houston multiple-unit system (more commonly known as "the master control"). Both these systems, though quite different, might be termed "indirect," inasmuch as the main current does not pass through the controlling gear.

The Westinghouse controller switch is conveniently placed on the driver's right, together with the controller lever of the Westinghouse quick-acting air-brakes, sand blast, siren, &c. The whole of the six motors per train are entirely under the control of the driver's switch, which is quite separate from the main circuit; the controlling current is taken from a 14-volt battery, one such being placed on each car.

There are eight stops on the controlling handle, four to the right for "forward" and four to the left for "reverse," the functions of these stops being as follows:—The first stop either way is a preparatory one. The second position of the driving

switch places the controller in position for backward or forward running. A "lap" position is inserted halfway between the second and third stops, and with the driving handle in this position the controller will remain stationary.

At the third definite position, a repeating and interlocking switch is operated, moving the controller "on" through the first stop by means of a ratchet and pawl. The same cycle is automatically repeated until the motors are in full series. When this position is reached, the controller is held there.

The fourth and last stop again establishes the circuit of the repeating switch, and the same cycle is repeated until the motors are in full parallel, when it is again interlocked.

A limiting switch is placed in the field of the motor, and is so arranged that should the current exceed a pre-determined limit, the repeating switch is short-circuited and the controller held stationary.

There are nine notches on the controller drum, which moves from the starting to the full speed position in about six seconds. The employment of a low voltage on the control is a great advantage, as it not only obviates risk of shocks to employés and momentary interruptions of the main circuit, but it also simplifies the switchgear and lengthens its life. A similar Westinghouse controller was illustrated in the Electrical Review of the 22nd ult., and a full description of the system was given in that of December 13th, 1901.

In the British Thomson-Houston system the main current does not go through the controller, but only the current for working the "contactors" and the reversing switch. These are shown on p. 966, there being 13 contactors per motor-car. The contactors constitute electrically-operated switches, and it is by opening and closing these electro-magnetically by the "master controller" that the various combinations of series and parallel are effected. A spring action combined with gravity opens the contactor on the interruption of the controller circuit.

Three of these contactors per car are wired in series, to ensure complete interruption of the main current in the off position. Should the train break in two, the motors on the part not under the driver's control are shut off automatically. The train control cable only carries the current necessary to operate the contactors. Continuity between the cars is preserved by a "jumper" having a couple of plugs at either end. The plugs contain nine insulated terminals, and fit into sockets on the cars, the latter being so shaped that the plugs will only go in in a certain way.

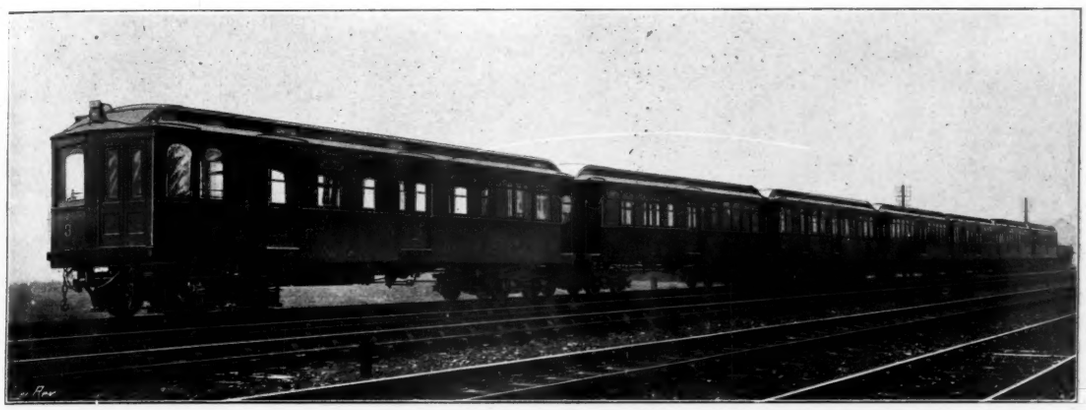
In the end motor-cars are placed magnetic blow-outs and switches in the motor circuit, and also switches and fuses in the "master controller" and contactor circuits. Should the contactor cut-out be opened, the master controller on that car is cut out, and the car becomes virtually a "trailer." This is especially useful in case of a breakdown.

Separate power and reverse handles are provided on the controller, which is provided with a strong magnetic blow-out coil to disrupt any arc when the contactors are opened. The power handle is known as the "dead man's handle," for should the driver for any reason release it, it flies back to the "off" position.

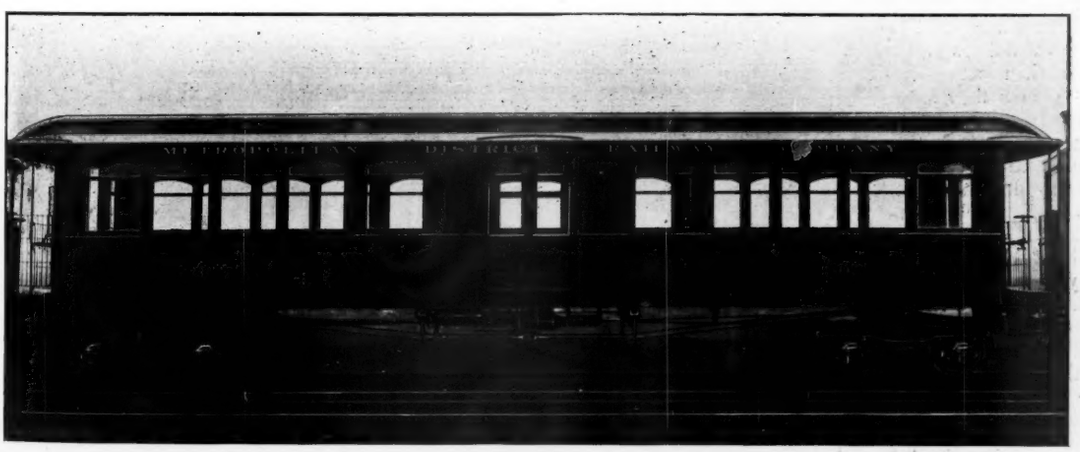
The British Thomson-Houston train is fitted with the Christensen air-brake.

Each train consists of seven coaches—three motors, and four "trailers"—a motor-coach being placed at each end of the train, and one in the middle. Two motors of about 160 H.P. each constitute the driving equipment per motor-car; the current for these is taken from the rails by six sets of collecting shoes, one set being placed at each end of every motor coach.

On entering the cars one is instantly struck by the design



Seven-Car Electric Train.



Trailer Coach.

and size. With a length of 50 ft., and a gangway about 45 in. broad between the two longitudinal seats, they seem very spacious when compared with the 22 ft. coaches of the District Railway. They are without their like in this country, with the exception of the trains for the Great Northern and City and the Mersey Tunnel Railway, the side exit doors in the centre forming a striking feature. It remains to be proved whether the facilities these extra doors afford more than repay the loss of the floor space allotted to them, which might otherwise have been used for seating accommodation.

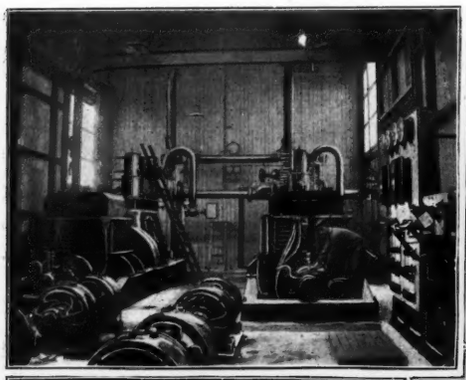
These side doors slide, and are provided with handles so that they can be worked either from within the car or from the station platforms. The exits at the ends of the cars are protected by gates which are operated by a conductor standing on the car platform. The advocates of this type of passenger car claim that it saves much time in the station stops, as compared with the ordinary British type of compartmental cars with separate side doors. It is also very useful to have a conductor on each car, to make the passengers move quickly and to call out the names of the stations.

There are seats for 48 passengers in the trailer cars, and for a few less in the motor-cars. There is plenty of room for standing without inconveniencing those sitting down, which can hardly be said of an ordinary compartment on a suburban train. No doubt if the Londoner be given real "rapid transit," he will not mind standing sometimes. To a certain extent this view is borne out by the experience of the Central London.

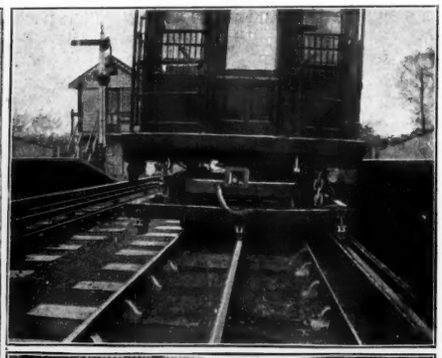
Cleanliness and protection from fire seem to have been the two fundamental objects in the design, and these are amply borne out by the skeleton rattan seats, asbestos-lined roofs, and the fact that the cars generally are built of "non-flammable" wood. The windows have a vertical movement, an innovation being made in the shape of internal sun-blinds. Electric heaters, 16 per car, have also been installed, and it is to be hoped the British public will appreciate these efforts to provide for their comfort. These heaters are wired in pairs, and are fixed under the seats, with a regulator at one end of the car. A luggage compartment is provided in the front and rear motor coaches adjoining the driving cabs.

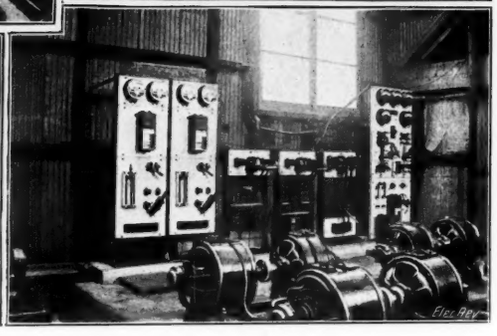
All class distinctions will probably be swept away, with the exception of provision for smokers and non-smokers, although no final decision has as yet been

Engine Room.



Front of Motor-Car.

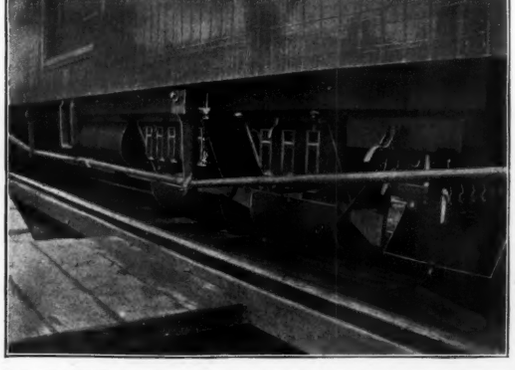




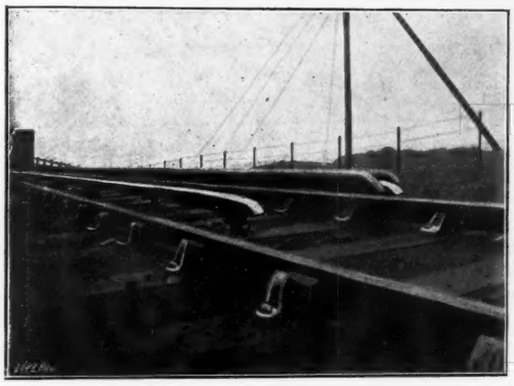
Battery Room.

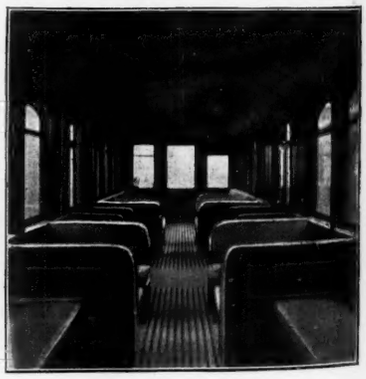
Boosters and Switchgear.

Contactors. (B.T.H. System.)



Train at Station.



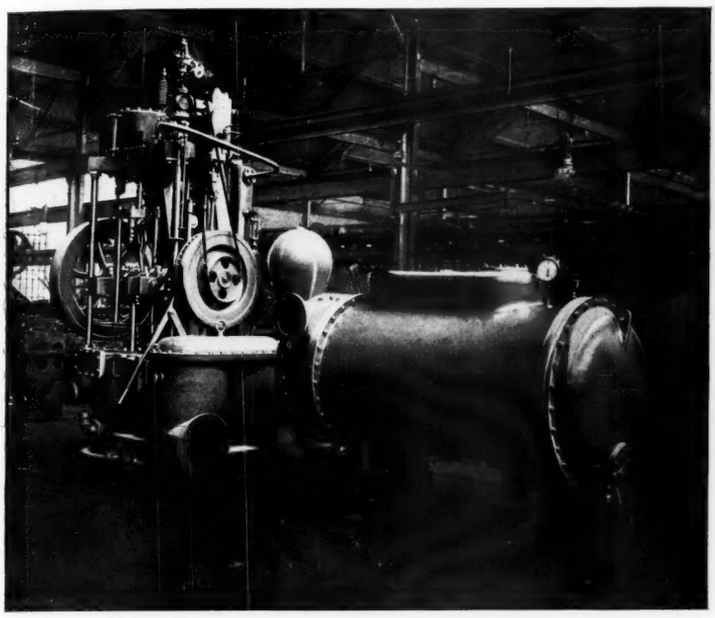


Arrangement of Track.

Interior of Car.

arrived at. How the fares shall be taken has also yet to be decided, and there is, no doubt, much to be said both for receiving them at booking offices, and for collecting them on board the train after it has started.

A temporary car depôt has been built at South Harrow, large enough to hold six cars at once for repairs, &c.



Rotherham: Condensing Plant.

The conductor rails are not run in here, as it would be obviously impracticable on account of the pits. A running lead has therefore been fixed in a gallery on the roof for the purpose of drawing the cars in and out of the shed.

Such, then, will be the rejuvenated District! Whether the enormous expenditure entailed by the transformation will ever be justified remains with the travelling public, but, when once completed, it will doubtless attract many of those who now patronise the 'buses, &c., rather than journey by the Underground in its present "smoky" state.

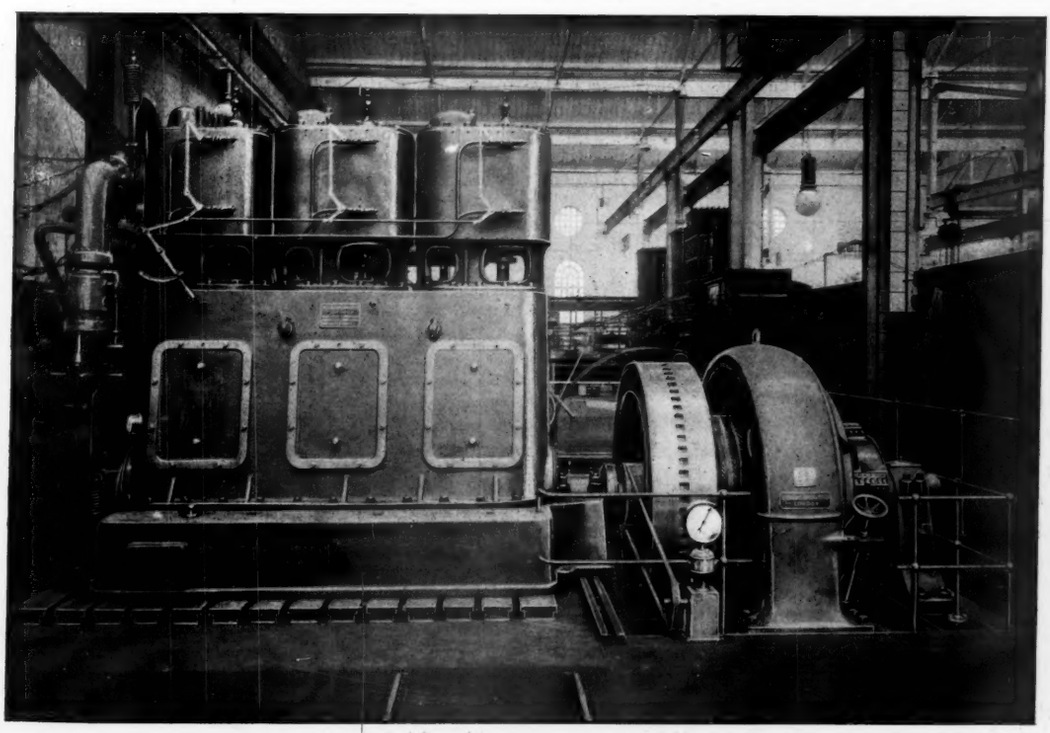
NEW PLANT FOR ROTHERHAM.

The rapid growth of electric traction in this country is instanced by the recent addition of generating plant found necessary by the Corporation of Rotherham to meet the increased demand on its tramway system. The following particulars relate to the Allen-Siemens combination just completed and now running.

The engine, made by Messrs. W. H. Allen, Son & Co., Ltd., of Bedford, is of their well-known enclosed, high-speed, three-cylinder compound, forced lubrication type.

The high-pressure cylinder is 15 in. in diameter; each of the low-pressure cylinders is 20 in. in diameter, and the stroke throughout is 12 in. The engine will give out 600 I.H.P. at 340 revolutions per minute with steam at 150 lbs. per sq. in. pressure at the stop-valve, condensing, and 500 I.H.P. at the same speed and pressure, non-condensing. The high-pressure piston is of cast-iron, and the low-pressure piston is of cast-steel.

The crankshaft is made from a solid forged bloom of Siemens-Martin steel, the eccentrics being solid with the shaft. This is the usual practice with this company, having been adopted after exhaustive experiments to enable the best position of the eccentrics to be found, which, once determined upon for any particular type, enables a complete solid shaft of the above description to be made, reducing the number of working parts to a minimum. The cylinders are of hard, close-grained cast-iron. The slide valves, of the solid piston type throughout, take the steam on the inside edges, thereby reducing the pressure on the glands and packing. The cylinders are tested hydraulically to double the working pressure; this is done after all machining and fitting has been completed, and when the discovery of any weak place



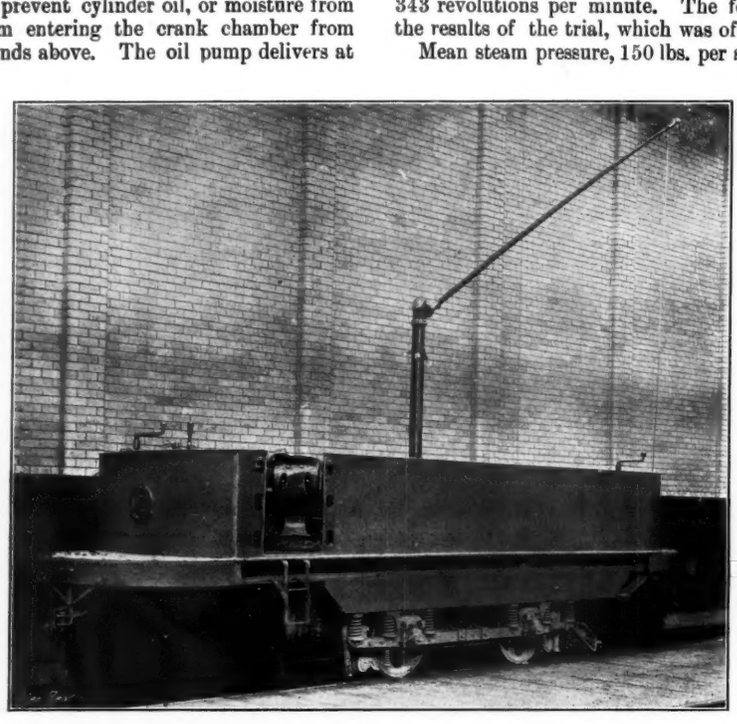
Rotherham: Allen-Siemens 600-I.H.P. Generating Set.

in construction is assured. The cylinders are lagged with asbestos, the experience of the company going to show that in this class of high-speed engines there is little to be gained by using steam jackets. The lagging is finally covered with planished steel, which gives the engine a very neat appearance.

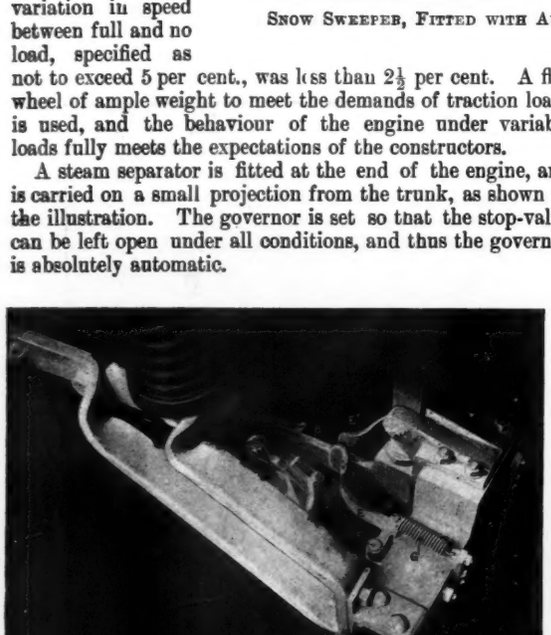
For the forced lubrication a special pump is used. Precautions are taken to prevent cylinder oil, or moisture from condensed steam, from entering the crank chamber from the steam cylinder glands above. The oil pump delivers at a pressure of 25—30 lbs. per sq. in.

The governor is fitted direct to the end of the crank-shaft, and revolves with it. Adjustment to the extent of 5 per cent. above and below the normal speed can be made while running. It was specified that on the removal of the load from full load to no load, the momentary variation in speed should not exceed 10 per cent.; a much nearer approximation than this was actually obtained, the variation up or down being less than 6 per cent., while the steady variation in speed between full and no load, specified as not to exceed 5 per cent., was less than 2½ per cent. A fly-wheel of ample weight to meet the demands of traction loads is used, and the behaviour of the engine under variable loads fully meets the expectations of the constructors.

A steam separator is fitted at the end of the engine, and is carried on a small projection from the trunk, as shown in the illustration. The governor is set so that the stop-valve can be left open under all conditions, and thus the governor is absolutely automatic.



Snow Sweeper, Fitted with Automatic Rail Cleaner. (See page 969.)



Automatic Rail Cleaner: Plan. (See page 969.)

The length of the bedplate is 126 in., the width 65 in., and the overall height of the engine 116 in. The overall length, including governor and fly-wheel, is 156 in.

It is worth mentioning that the engine is constructed on the limit gauge system throughout, examiners being placed in the various departments in the works, who have full authority to condemn any part not within the limits specified by the directors.

The engine is coupled direct to a Siemens compound multipolar generator, capable of giving 320 KW. at 460—520 volts as a shunt machine, or 500—550 volts as a compound machine, at a speed of 340 revolutions per minute.

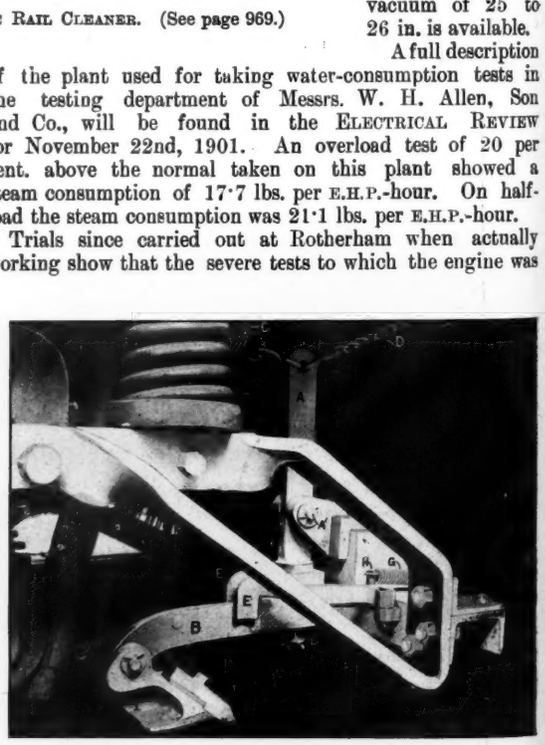
At the trials made at the Queen's Engineering Works, Bedford, on February 20th and 21st, 1903, the mean steam consumption (condensing) at full load was 18·53 lbs. of steam per E.H.P.-hour, and the mean steam pressure at the stop-valve 150 lbs. per sq. in. when running at a speed of 343 revolutions per minute. The following data represent the results of the trial, which was of six hours' duration :—

Mean steam pressure, 150 lbs. per sq. in. Mean speed 343 revs. per min. Mean I.H.P. 499. Mean E.H.P., 433, = 323 KW. Total water, 8,022·6 lbs. Water per E.H.P. - hour, 18·53 lbs. Water per KW.-hour, 24·85 lbs. Mean vacuum at engine exhaust, 22 in.

The low vacuum was due to a deficiency in the water supply for circulating in the auxiliary condenser used for testing this plant, the temperature of the circulating water supply rising from 90° to 100° F., during the latter part of the run. The engine itself should show better results than given by test when a vacuum of 25 to 26 in. is available.

A full description of the plant used for taking water-consumption tests in the testing department of Messrs. W. H. Allen, Son and Co., will be found in the Electrical Review for November 22nd, 1901. An overload test of 20 per cent. above the normal taken on this plant showed a steam consumption of 17·7 lbs. per E.H.P.-hour. On half-load the steam consumption was 21·1 lbs. per E.H.P.-hour.

Trials since carried out at Rotherham when actually working show that the severe tests to which the engine was



Automatic Rail Cleaner: Elevation. (See page 969.)

subjected before being sent out meet the actual requirements when at work in a very satisfactory manner.

The additional condensing plant supplied, consists of a surface condenser, and a combined steam-driven air and circulating pump. The condenser has a tube surface of 1,000 sq. ft. The circulating water flows through the tubes, a division plate being placed at one end, which causes the water to traverse the whole length of the con-

denser twice during its passage through it. The illustration on p. 967 shows the plant in the erecting shop of Messrs. W. H. Allen, Son & Co., who are the makers of this plant also. The steam passes round the outside of the tubes, a perforated naval brass plate being used to distribute the steam over the upper surface of the condenser. The air and circulating pumps are driven by a compound engine having cylinders 9 in. and 15 in. in diameter, the stroke being 11 in. The cylinders are lagged with asbestos, and covered with planished steel. The high-pressure cylinder drives direct on to the circulating pump and the low-pressure cylinder direct on to the air pump. The plant is provided with an adjustable "Pickering" governor.

The circulating pump is double-acting, has a plunger 15. in in diameter and a stroke of 11 in., and discharges into a valve box, which is fitted with air vessels on the suction and delivery sides, the whole being designed for steady running and freedom from shock. The air-pump is of the well-known Edwards type, the bucket having a diameter of 20 in. and a stroke of 11 in.

A crankshaft is placed midway in the arrangement, and provided with a suitable fly-wheel to ensure steady motion. Barring gear is also provided for starting purposes.

The normal speed of the plant is 120 revolutions per minute, and in order to meet the requirements for continuous running, the oil for lubricating purposes is distributed by an arrangement of pipes from a central oil box.

The tubes of the condenser are of condenser brass, chosen with a view to reducing corrosive action to a minimum, and the condensers are made so that these end covers can be readily removed at any time to enable the condition of the tubes to be determined.

AUTOMATIC RAIL CLEANER.

In the illustrations on the opposite page we show a new automatic track rail cleaner for electric tramway use, which has been introduced by Messrs. Brecknell, Munro & Rogers, of Bristol. The idea is to scrape the groove and tread of the rail, the cleaner being automatically kept in line with the wheels of the car. It is claimed that the cleaners will pass through all frogs, points and crossings without the least forcing or kicking, and should they accidentally be thrown out of the rail it is impossible for them to take up any other position than one in line with the flanges of the wheels, in which position they are easily lowered into the groove when on a straight line.

They will take curves down to 28 ft. radius, and in practice, so far, have always proved reliable and automatic. They may be fixed in advance of the truck, as is shown in the accompanying view of one of the makers' snow-sweepers.

For such sweeper use it is the custom to fit one cleaner at each end, this being sufficient to run the machine during heavy snow, but in passenger car service two cleaners can be fitted at each end of the car if desirable. The operation of the mechanism is effected as follows :—The lever A is fulcrumed at A^1, and lever B is mounted on lever A by a swinging joint at B^1, which permits of a swing movement in a horizontal plane. This compound movement allows the shoe to take up any position on a curve, and to be under the full control of the tension spring C at the same time; similarly, the lifting chain D may be used by the motorman to pull the cleaner out of the rail.

Upon reference to the figures, the levers E and E^1 will be noted; they are mounted upon the buffer beam, and are fulcrumed at F, the heel H taking the pull of the spring G. It will be seen that any lateral movement of the cleaner will force one of these levers, E or E^1, as the case may be, out of its normal position. Spring G is thus extended, and exerts a gentle pressure upon the lever B for the purpose of maintaining it in line with the wheel. When going round a curve, the shape of the shoe I keeps it in the groove of the rail; but should the shoe accidentally jump out of the groove, the spring-control levers E and E^1 prevent it from flying abroad, and on getting over the next piece of straight line, the motorman can lower the cleaner into the groove again by means of a handle conveniently situated on the dash, and coupled up to the chain D. The steel scraper J is hardened, and will clean about 1,000 miles of track. The pressure on the rail is regulated by the spring C, which is adjustable.

ELECTRIC LIGHT AND POWER NOTES.

(*Continued from page* 963.)

Auckland, N.Z.—Mr. Goodman, agent for Noyes Bros., who recently returned from Europe and America, has submitted his plans for the lighting of Auckland by the city authorities. We learn from the *Australasian Hardware and Machinery* that he suggests two alternatives—the carrying out of the scheme by the City Council on its own account, or the granting of concessions to a private company to supply light and power. The Council, he thinks, would do well to instal its own plant, and suggests that arc lighting should be employed in the main thoroughfares, while the narrow streets could be lighted with incandescent lamps. Altogether 189 arc lamps would be required. The mains would be carried underground in the principal streets of the city, and overhead in the outlying portions, and the area lighted would approximate 18 miles of streets by arc lights and 36 miles by incandescent. Steam plant is recommended for generating purposes, as a gas plant would be more expensive. The cost of the system is estimated at £74,000, and the revenue is expected to reach £18,099—£10,705 from lighting and £7,394 from motive power. As the cost of generation and distribution is estimated to reach £12,173, a profit of £5,926 per annum is shown. The arc lighting for the first year would cost £2,573, which, compared with the Gas Co's present bill of £1,600, would show a difference of £973 against the new illuminant, which would reduce the estimated profit to £4,953 per annum. These estimates refer to the city proper. If all the suburbs embraced in the larger Auckland scheme were included, the number of arc lamps would be increased by 73, and the number of incandescent lamps by 3,475. A plant capable of meeting this larger demand would cost £130,000. The charges for interest and maintenance would total £21,336, and the revenue £29,976 yearly, leaving a net profit of £8,640. The British Electric Traction and Power Co., who only recently installed an electric tramway system, has also offered to supply the needs of the city in the matter of light. It is urged that it is able to do so more economically than any other supplier because the present 1,000-H.P. installation could be doubled without doubling the expense.

Lancaster.—The report of the electricity department shows a net surplus on the year's work of £1,353, a figure £422 in advance of the previous year. The committee is now building up a strong reserve fund, which amounts at present to £2,484. Since 1896 it has assisted the district fund to the extent of £2,723. The income from the sale of energy last year was £6,324, against £5,549; from public lighting, £584; sale and repairs to lamps, £241. On the expenditure side the cost of generating was £2,428; distribution and management expenses, £1,086; rents, rates and taxes, £351; debt redemption, £576; interest on capital debt, £694; interest on mortgages, £314. The capital expenditure on the electricity works has been increased during the year by £15,849, to £55,195.

New Zealand.—Mr. Allo, the eminent Swiss hydraulic and electrical engineer, who is now on an official tour by invitation of the Premier, made a report on the electrical possibilities of the Waipori Falls. He calculates, says an Australian exchange, that about 4,500 H.P. will be available in the city of Dunedin. He also visited Auckland Province to report on the Huka Falls as a means of electrical development. These falls are 180 miles from the city of Auckland. It is estimated that at the dry season 39,000 H.P. could be obtained, an amount sufficient to meet all the requirements of the North Island. It is suggested that the electricity generated at these falls should be conveyed in four different directions—towards Auckland, Wellington, New Plymouth and Napier.

Newark.—The electric light question formed the chief topic of debate at a monthly meeting of the T.C. The Electric Lighting Committee reported that a communication was recently received from the Derby and Notts. Electric Power Syndicate, stating that it was willing to take up the agreement which had been tentatively arranged, and enclosing a draft agreement amended to suit the altered circumstances. The Committee recommended the Council to enter into an agreement with the syndicate on the terms of the draft, but with the addition of words providing that in the event of purchase the amount paid for public lighting should not be taken into account in calculating the value of the undertaking. Mr. Stennett moved that the Committee should be instructed to present a Corporation electric scheme for the approval of the Council. In the course of the discussion, it was contended that the syndicate could work the scheme more economically than the Corporation. Upon a division, the resolution was rejected by thirteen votes to four, and the Committee's report was adopted.

Newcastle-on-Tyne.—The Corporation Tramways Committee has been asked to supply the Town Hall with electricity for lighting purposes from its power station.

At a meeting of the Council a report was presented with reference to the proposed lighting of public buildings in the city with electric light. The report dealt not only with the comparative cost

of gas and electricity, but also with the cost of current taken from various supply companies and from the Corporation power station at the Manors. The figures submitted showed in favour of the Corporation supply as being less costly, and the report was referred to a sub-committee.

Newton Abbot.—The U.D.C. has affixed its seal to the agreement with the Urban Electric Supply Co. for electric lighting.

Perth.—The Secretary for Scotland has acceded to the request of the Council for power to apply for a loan of £7,000 for the purpose of extending the electric lighting plant.

Peterborough.—The Corporation is contemplating a considerable extension of their scheme for street lighting.

Ripon.—By eleven votes to two the T.C. has decided to apply to the B. of T. for a renewal of the E.L. order, which expires in July, for a period of three years, and not to transfer the order to the B.E.T. Co.

St. Helens.—The Electricity and Tramways Committee has decided to extend the plant at the electrical generating station. Gas engines are to be installed for driving the additional machinery.

Watford.—The U.D.C. has decided to have a coal conveyor erected at the E.L. works. This will effect a saving of £69 per annum.

Wednesbury.—On Wednesday in last week Mr. F. H. Tulloch, M.Inst.C.E., one of the Local Government Board inspectors, held an inquiry respecting an application by the Corporation for sanction to borrow £11,000 for electric lighting purposes. The town clerk stated that the Corporation had received many applications from the inhabitants for a supply, and no opposition to the application for the desired loan had so far been shown. The energy would be obtained from the Midland Electrical Corporation for Power Distribution, Ltd., which had obtained a provisional order to supply electricity in the borough and to the adjoining authorities. The cost of electricity to the Corporation would be about 3⅜d per unit on the maximum demand one-hour system. The maximum demand would be kept as low as possible. It was estimated that the quantity of electricity that would be required from the company was over 154,000 units per annum, and the standing charges were expected to amount to £1,115 per annum. There was no opposition to the application.

Willesden.—The District Council will, it is expected, be in a position to supply electricity in a couple of weeks' time.

York.—The report of the E.L. Committee recommending the acceptance of a tender for the extensions to the works on Foss Island, amounting to £13,280, was adopted.

ELECTRIC TRACTION NOTES.

Brighton.—The accounts of the tramway department show a surplus of £4,134 during the year ended March 31st.

Cardiff.—The Bute Street to Splottland section of the tramways, bringing the system up to about 16 miles of lines, was formally opened the other day by the Mayor, who started the first car. His worship was subsequently presented with a pair of controller handles. The line was afterwards open for traffic, six cars being available. At the subsequent proceedings Mr. Coates said that when the tramway accounts were audited, it would be found that up to the end of March last, which was an incomplete year, after paying the loan charges and making other provisions, there would be a surplus of something like £9,000 or £10,000.

Cleveland.—The Councils of Middlesbrough, Ormesby, Normanby and Eston, have decided to engage an expert to prepare a scheme for the local authorities to construct electric tramways between Middlesbrough and Eston.

Glasgow.—The extension of the Corporation tramways to Clydebank has now been opened. The through route is from London Road to Clydebank, a distance of 8¾ miles, for which the fare is 4d.

Johnstone.—It is expected that in the course of the next few weeks a commencement will be made with the work of laying the rails for the new electric tramways.

Motherwell.—By a serious subsidence of the ground at Motherwell much damage has been done to the power station in connection with the Hamilton, Motherwell and Wishaw tramway scheme, and the inauguration of the cars which was promised early this month will be postponed for an indefinite period. The structure, which consists of brick and was only completed a few weeks ago, is rent from top to bottom. The foundations of the car-sheds have sunk from 1 ft. to 18 in., and the chimney stack has subsided 1½ ft., although, fortunately, it remains in its perpendicular position. In the engine and dynamo house the movement of the ground has been found to be most serious. Here most of the plant had been laid down, but the engineers found it impossible to secure their levels for an hour at a time. Their endeavours to set the engines were rendered futile, and operations had to be suspended. The boilers, when filled with water, sank 1½ in., and many of the couplings became disjointed. It is anticipated that many months must elapse before the ground can be considered stable and safe.

Leith.—In a report to the Tramways Committee of the Leith Town Council, Mr. Jas. More, C.E., advised the Corporation to purchase the tramways from the company, and suggested the immediate conversion of the undertaking to the overhead electric system, the electric energy to be supplied from the Corporation installation at the rate of 1½d. per unit. He suggested that there should be a service of 29 cars, and expressed the opinion that the system could be completed in about a year's time. The Tramway Co.'s previous demand for the purchase of the undertaking was £90,000, but this the Council considered excessive. On Monday a Sub-Committee of the Town Council met the directors of the Tramway Co. and offered £60 000 as the purchase price. The directors contended that this was too low a figure, but agreed to consider the offer and communicate their reply.

Newcastle-on-Tyne.—At a meeting of the Tramways Committee on the 28th ult., it was agreed to accept the tender of the Tees-side Engineering Co. for the raising of the Scotswood Road bridge so as to enable the double-deck cars to pass under. The amount of the tender is said to be £1,323, or about £2,000 less than a scheme for lowering the roadway. Messrs. Ridley & Co. have been entrusted with the work of raising the Walker Road bridge, the cost being put at £2,208.

Peterborough.—The Peterborough Electric Traction Co. recently applied to the T.C. for permission to take up certain pathways for the purpose of extending their cables. The T.C., however, declined to give the necessary order, on the ground that the pathways had been recently made with concrete, and that the cable could be taken overhead. The Traction Co. then made a representation to the Board of Trade, who have overridden the action of the Town Council, and informed that local body that the objection they raised was unreasonable. On May 29th the company applied for permission to make an additional passing place near the entrance to the Agricultural Show Ground. Several members argued that the passing place was evidently intended for the purpose of facilitating traffic at the annual show, and that the Town Council should remember that many owners of vehicles in the city looked upon the show days as their harvest. It would not be right for the electric cars to monopolise all the traffic. The town clerk said the Council had already received one snub from the Board of Trade because they ventured to raise an objection to an application of the company, and he thought the Council had little power in the matter. The question was delegated to a committee.

Radcliffe.—Negotiations are taking place between the U.D.C. and Bury (Lancs.) T.C. for the provision of electric trams for Radcliffe. By the scheme it is proposed that the Bury system shall be extended to Radcliffe, the Corporation to provide the overhead equipment and the cars, and the U.D.C. to construct and maintain the lines; Bury to pay 3½ per cent. on the sinking fund, and the profits to be equally divided.

St. Helens.—The Corporation is continuing its opposition to the South Lancashire Tramways Bill. At a meeting of the sub-committee of the Electric Supply and Tramways Committee on Tuesday, the town clerk reported that the Committee of the House of Lords had granted the company running powers over the tramways of the Corporation for passenger traffic only. The South Lancashire Tramways Co. have been trying for the last two years to obtain sanction for carrying goods traffic over the St. Helens tramways, but seem as far as ever from obtaining the sanction sought. The sub-committee resolved to recommend that the opposition to the company's Bill be continued in the House of Commons.

Southport.—At a meeting of the Tramways Committee last week it was stated that the exact loss on the year's working was £1,222.

Sunderland.—The annual report of the Corporation Tramways has just been issued, and gives a full *résumé* of the year's workings. It notes that the principal works of the year have been the completion of the Fulwell route and the Hylton Road depôt and repairing sheds. As to statistics, these show that during 1902-3 the passengers carried numbered 13,987,121, as compared with 13,596,808 for the previous year, an increase of 390,315. The total receipts from passengers were for 1902-3, £59,142, as against £56,243 for 1901-2, being an increase of £2,899. The average number of cars used daily was 43 as against 36 for 1901-2. The distance travelled was 1,270,957 miles as compared with 1,170,207 for 1901-2, an increase of 100,750. The details of the income were as follows:—

Traffic receipts	£59,142 10 2		
Rents	8 15 0		
Advertising on tickets	141 9 6		
Bank interest	583 13 7		
Interest invested reserve fund	103 13 11		
		£59,980 2 1	
Expenditure:—Working expenses	£34,065 11 2		
Interest, sinking fund and depreciation ..	20,131 0 0		
		54,196 11 2	
Net profit		£5,783 11 0	

The income per car-mile was 11·31d.; working expenses per car-mile, 6·43d.; interest, sinking fund and depreciation, 3·8d.; making the total expenses per car-mile 10 23d., and leaving a net profit per car-mile of 1·08d. The analysis of expenses shows that 1,335,660 units of energy were consumed, and cost £11,130. The wages of motormen, conductors, &c., were £11,530; uniforms, &c., cost £1,046; and compensation for injury, £289. Cleaning cars cost £2,034; repairs and maintenance of rolling-stock, £3,478; repairs and maintenance of electrical equipment cost £449; and repairs and maintenance of permanent way cost £724. Out of the net revenue there was paid £5,000 towards the borough rate, £11,915

was put aside for depreciation, and £7,820 was paid for interest on the mortgage debt. The report also gives a good many figures as to the traffic, showing the receipts from each route, &c.

Spain.—Plans have been completed for the construction of the first section, between Mondariz and Porrino, of a light electric railway between Mondariz and Vigo. Water power is to be utilised in the generation of the necessary electrical energy.

Swindon.—The T.C. has received from the B. of T. sanction to borrow £36,294 for electric tramway purposes.

Victoria.—There is a scheme under consideration here for an electric railway to be laid along the beach from St. Kilda to Brighton. Mr. Holmes, the electrical engineer to the Victorian Railways Department, said that the cost would be something like £135,000, but the revenue would be mainly derivable from holiday traffics. He favours an alternative scheme, which consists of an electric tramway following an entirely different route and costing about £84,000.

Wolverhampton.—At a meeting of the Tramway Committee last week a letter was received from Mr. Wetmore, the local representative of the Lorain Co., in reference to the resolution passed at the last special meeting of the Town Council, a copy of which has been sent to him in the ordinary way. The letter asked the Corporation, through the Committee, to point out wherein the Lorain Co. had failed in the matter of fulfilling the contract. A formal reply was ordered to be sent to Mr. Wetmore. Subsequently the Committee gave instructions to Mr. C. E. C. Shawfield, the borough electrical engineer, to prepare estimates and specifications for the overhead system. This work will be undertaken at once. The Committee also dealt with tenders for the laying of the track for the Willenhall, Dudley Road, and Wednesfield routes. Finally, a resolution was passed containing a recommendation to the Town Council that the contract be given to Mr. H. Holloway.

TELEGRAPH AND TELEPHONE NOTES.

Anglo-Belgian Telephones.—The Brussels correspondent of the *Morning Advertiser* says that the telephone service between London, Antwerp, and Brussels will start on June 8th. The price for a conversation has been fixed at 8s. 4d. for three minutes. Newspapers will be given special rates—5s. for ten minutes' conversation. They will be able to use the wire from 8 o'clock in the evening until 8 o'clock in the morning.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
St. Vincent-Grenada	May 8, 1903	May 29
St. Lucia-St. Vincent	Sept. 19, 1902	
Reisa-Issa	Oct. 22, 1902	
Reisa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 18, 1903	
Landlines.		
Dagua-Buenaventura	May 14, 1903	May 29
Assab-Massowah	June, 1, 1903	

Wireless Telegraphy.—It is reported that Mr. Edison has joined hands with the American Marconi Co.

CONTRACTS OPEN AND CLOSED.

OPEN.

Beckenham.—June 22nd. Electricity meters. See "Official Notices" to-day.

Bradford.—June 13th. Tenders are wanted by the Corporation for the lighting of the Cartwright Memorial Hall. Tenders are wanted by the Guardians for the lighting of the Sanatorium for consumptives at Eastly, near Skipton.

Bray.—June 15th. Transformers, mains, and pipework for the electricity works extensions. See "Official Notices" to-day.

Brighton.—June 8th. The Council wants tenders for 5,400 KW. generating plant at Southwick power station, and 5,000 KW. motor-generator converting plant, together with switchboards, instruments, &c., at North Road power station. See "Official Notices" April 17th.

Burma.—June 26th. The Burma Railways Co., Ltd., wants tenders for an electric light and power plant for the Insein workshops. Particulars, specifications, &c., from C. E. Cardew, locomotive and carriage superintendent.

Colchester.—June 10th. Traction switchboard for the electricity works. See "Official Notices" May 29th.

Colchester.—June 22nd. Feeder cables, overhead equipment and cars. See "Official Notices" to-day.

Derby.—June 16th. Rails, tie-bars, points, crossings, excavation and other roadwork, poles, overhead wiring, feeders, and cars for the Corporation tramways. See "Official Notices" May 29th.

France.—June 9th. Tenders are being invited until June 9th by the French Post and Telegraph authorities in Paris for the supply of a quantity of telephone cables in five lots. Tenders are to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

Gloucester.—June 16th. Generating plant (two 200-KW. sets), condensing plant, pipework, switchboard, battery and boosters for the city light railways. See "Official Notices" May 8th.

Gloucester.—June 16th. Rails, permanent way, cables, pillars, poles, overhead work, cars, trucks, and equipments, for the City Light Railways. See "Official Notices" May 22nd.

Hungary.—August 31st. Tenders are being invited until August 31st next by the municipal authorities of Besztercebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Italy.—June 10th. Tenders for the Mediterranean Railway authorities for a 10-ton electric crane at the railway station at Florence.

Johannesburg.—June 15th. Rails, points and crossings, tie-bars, &c., for the electric tramways. See "Official Notices" May 1st.

Leeds.—June 8th. Messrs. Graham, Morton & Co., Ltd., want tenders for a private telephone installation at their new works. See our "Official Notices" May 22nd.

Littleborough.—June 9th. Electric lighting of Council offices, public library, fire station, &c., together with the necessary generating plant.

Manchester.—June 15th. Two groups of three single-phase transformers of 60-KW. each; high-tension cables. See two "Official Notices" to-day.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Rangoon.—July 1st. The Municipal Committee wants tenders for carrying out its electric lighting license, and particulars, forms, &c., can be obtained from the officiating secretary (W. Shircore), Rangoon municipality, at Rs. 75 per set.

Salford.—June 20th. Pilot and telephone wires for the tramway poles. See "Official Notices" to-day.

Southampton.—June 11th. Low-tension distributing cable. See "Official Notices" May 29th.

Southend.—June 15th. 10,000 pairs of flame carbons. See "Official Notices" May 29th.

Spain.—June 14th. The municipal authorities of Mora (Toledo province) are inviting tenders until June 14th for the concession for the electric lighting of the town during a period of six years. Tenders are to be sent to, and particulars may be obtained from, El Secretario del Ayuntamiento de Mora (Toledo).

Stepney.—June 22nd. Meters and demand indicators for a year. See "Official Notices" to-day.

Wood Green.—June 24th. Underground mains, and roadwork for private lighting. See "Official Notices" May 29th.

CLOSED.

Ayr.—Messrs. Babcock & Wilcox are to supply a new boiler for the electricity works.

Bermondsey.—The B.C. received on Tuesday the following tenders for the supply of 4 in. conduits:—Albion Clay Co. (accepted), Sykes's patent stoneware conduits with self-centring joint, 2-way, 2s. 9½d. per yard, 3-way, 3s. 10d., 4-way, 4s. 10d., 6-way, 7s. 8d.; Mansfield, best quality salt glazed stoneware spigot and socket joints, 2-way, 2s. 11½d., 3-way, 4s. 3½d., 4-way, 5s. 2d., 6-way, 8s. 6½d.; Sutton & Co., Sutton's patent conduits (socketed), 2-way, 2s. 3d., 3-way, 2s. 4½d., 4-way, 4s. 6d., 6 way, 6s. 9d.; Doulton, including joint cradles, 2-way, 3s. 2d., 3-way, 4s. 8½d., 4-way, 5s. 11d.; John Knowles, Stamford socketed conduits, 2-way, 3s. 5½d., 3-way, 5s. 2d., 4-way, 6s. 4d., 6-way, 10s. 2d.

Croydon.—For extensions to boiler house at electricity works for Croydon County Council, the tender of S. Page & Son, at £1,258, has been accepted.

Glasgow.—The following tenders have been accepted for cables for the electricity department for a year:—Callender's Cable Co., Craigpark Co. and Anchor Cable Co. Messrs. Siemens Bros. are to supply india-rubber goods; the Reason Manufacturing Co., demand indicators; and Messrs. Chamberlain & Hookham, meters.

Induction motors for the Waterloo Street station are to be supplied by the British Westinghouse Co. at £2,910; H.T. switchboards, &c., by the B.T.H. Co., at £548; and an additional boiler by Babcock & Wilcox, at £1,406.

Hartlepool.—The contractors for the arc lighting here, Messrs. Crompton & Co., Ltd., have accepted the tender of Messrs. Rowland Carr & Co. for the supply of 40 arc lamp columns.

Launceston (Tas.).—The City Council has by 4 votes to 3 accepted the tender of Messrs. Kolben & Co. for four three-phase generators, each with turbine, also the switchboard for £6,000. It is said that the Kolben tender was the lowest received; the others sent in ranged up to £16,000.

Malta.—It is stated that the concession for a modern system of tramways for Malta has been awarded to Messrs. Macartney, McElroy & Co., Ltd.

Stalybridge.—On May 29th, the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board accepted the following tenders:—Messrs. Bolckow, Vaughan & Co., Ltd., for 100 tons of rails; the British Westinghouse Electric and Manufacturing Co., Ltd., for 20 double-deck tramcars, with bodies, manufactured by the British Electric Car Co., Ltd., and trucks by the European McGuire Manufacturing Co., Ltd.

Wirral Railway.—It is reported by a Bradford paper that a contract has been signed between the directors of the Wirral Railway Co. and the British Westinghouse Co. for the electrification of the railway on the same system as that now working on the Mersey Tunnel Railway. The Wirral Railway, about 15 miles in length, connects Liverpool by means of the Mersey Railway with the residential district of the Wirral peninsula in Cheshire, West Kirby and New Brighton being the terminal points.

FORTHCOMING EVENTS.

Friday, June 5th.—At 5 p.m. Physical Society. Special meeting at University College. Prof. Rutherford, of Montreal, on "Radio-Active Processes." A discussion will follow, in which it is hoped that several prominent physicists will participate.

Saturday, June 6th.—At 3 p.m. Royal Institution. Prof. S. P. Thompson on "The 'De Magnete' and its Author." (II.—The Man.)

At 10 a.m. I.E.E. (Students' Section). Visit to the works of Messrs. Elliott Bros.

Monday, June 8th.—At 7.30 p.m. Society of Engineers. "Electric Light Stations: their Design and Arrangement" (illustrated by drawings of the Bridlington Electric Light Station), by Mr. Ernest R. Matthews, C.E., F.G.S.

Thursday, June 11th.—At 3 p.m. Exhibition of Practical Work executed by City and Guilds candidates, at the Imperial Institute (North Gallery), to be opened by the Marquess of Londonderry.

At 7.30 p.m. Royal Albert Hall. Invitation Concert by the I.E.E. President, in connection with the International Telegraph Conference.

THE FIFTH INTERNATIONAL CONGRESS FOR APPLIED CHEMISTRY, BERLIN, JUNE, 1903.

[FROM OUR SPECIAL CORRESPONDENT.]

Berlin, *June 2nd*, 1903.

The meeting of the fifth International Congress for Applied Chemistry may be assumed to have some interest for readers of the Electrical Review, since the meetings of Section X of this Congress have been organised by the Deutsche Bunsen Gesellschaft, the German Society of Electro-chemists, and the 1903 meeting of the latter Society has been merged in the meeting of Section X of the International Congress.

The four previous meetings of the International Congress have been held at Brussels, Paris, Vienna and Paris respectively in the years 1894, 1896, 1898 and 1900. It is, therefore, three years since the last Congress was held, and the assembly has now become triennial in character.

The Imperial Government has marked its sense of the honour conferred on Berlin by its choice as meeting place for the Congress by handing over the Reichstag Buildings to the Organisation Committee for the Congress week. And all the general and sectional meetings of the members of the Congress will, therefore, be held in the Parliament Buildings of the German Empire.

Some 1,500 chemists are expected to take part in the general and sectional meetings, and a preliminary list of 1,200 members has already been published.

A large number of social functions have been arranged for the entertainment of members during the Congress week, June 2nd to June 8th. As evidence that the social character of the Congress has not been allowed to overshadow its scientific character, it may be remarked that no less than 44 reports and 124 papers have been received for presentation to the 11 sections into which the Congress is divided, and that many of the reports and papers may be expected to lead to most interesting discussions.

Of the general meetings of the Congress members, that planned for Friday, June 5th, is likely to be the most successful. At this meeting the distinguished French chemist, Henri Moissan, is to deliver a lecture on the "Metallic Hydrides," while England is honoured by the selection of Sir William Crookes to discourse upon "Radium."

The following is the preliminary list of papers and authors for Section X., with the dates which have been arranged for reading the former. It will be seen that the programme is somewhat full, and it is doubtful whether time will permit an adequate discussion of many of the subjects. This is the more to be regretted, as at meetings of an international character, the discussions are the most valuable feature when well organised.

Wednesday, June 3rd.

1. Prof. Nernst, Göttingen, "Vapour Density Determination at Very High Temperatures."
2. Dr. O. Frölich, Berlin, "A New Electric Resistance Furnace."
3. Prof. Bancroft, Ithaca, "Experiments with Metallic Diaphragms."
4. Prof. Brochet, Paris, "Electrolytic Manufacture of Barium Hydrate."
5. J. B. C. Kershaw, London, "Aluminium as Metal for Electrical Purposes."
6. Prof. Traube, Berlin, "Experiments Bearing on the Critical Density."

Thursday, June 4th.

1. Dr. Wedekind, Tübingen, "Zirconium in the Colloidal State."
2. Prof. Moissan, Paris, "The Metal Carbides."
3 and 4. Prof. Foerster and Direktor Brandeis, Aussig, "The Utilisation of Electrolysis for the Manufacture of Inorganic Compounds."
5. Prof. Le Blanc, Karlsruhe, "Electrolysis with Alternating Currents."
6. Prof. Lebeau, Paris, "The Silicon Products of the Electric Furnace."
7. Prof. Coehn, Göttingen, "Electrolytic Reduction and Oxidation."
8. M. Gin, Paris, "Manufacture of Aluminium."
9. Dr. Goldschmidt, Essen, "The Production of Steel in the Electric Furnace."
10. G. R. Taylor, Plum Tan, New York, "The Manufacture of Carbon Bisulphide in the Electric Furnace."
11. Prof. Küster, Clausthal, "Dissociation Pressure of Soda Solutions."
12. Prof. Guntz, Nancy, "The Production of Barium."

Friday, June 5th.

1. Prof. Nernst, Göttingen, "Electro-Chemical Units."
2. Dr. Schenck, Marburg, "The Decomposition of Carbon-Monoxide."
3. M. Ancel, Paris, "Variations of Electric Resistance under the Influence of Light."
4. Prof. Zengelis, Athens, "High Temperature Reactions and their Industrial Applications."
5. Dr. Bodenstein, Leipzig, "Chemical Kinetics of the Contact Sulphuric Acid Process."
6. Prof. Marckweld, Berlin, "Radio-Active Substances."

Saturday, June 6th.

1. E. Solway, Brussels, "A Gravity Formula for Diffusive Phenomena."
2. Prof. Goldschmidt, Christiania, "The Modern Theories of Affinity and Organic Chemistry."
3 and 4. Prof. Elbs Giessen and Dr. Buchner, Mannheim, "Electrolysis and the preparation of Organic Compounds."
5. Prof. Sabatier, Toulouse, "Hydrogenation by Catalytic Action."
6. Prof. Bodländer, Braunschweig, "The technical applications of Catalytic Action."
7. Dr. Grossmann, Münster, "Complex Compounds of the Sulphocyanide Radicle."
8. Dr. Erlwein, Berlin, "The use of Electricity for fixing the Nitrogen of the Air."

9. Dr. Sinding-Larsen, "Pseudo-Molecular Compounds."
10. Prof. Bredig, Heidelborg, "Electrical Endosmose and the Colloidal State."
11. Dr. Schwerin, Höchst, "Practical Applications of Electrical Endosmose."
12. Prof. Magnanini, Modena, "The Physical Chemistry of Wine."

Monday, June 8th.

1. Dr. Sinding-Larsen, "Capillarity Phenomena and Osmotic Pressure."
2. Prof. Bancroft, Ithaca, "Constant Voltage and Constant Current Separations."
3. Director Nissluan, Stolberg, and Dr. Dauncel, Breslau, "Electrolytic Methods of Analysis."
4. "Dr. Monti, Turin, "Concentration of Solutions by Freezing."
5. Prof. Goldschmidt, Christiania, "The Kinetics of Reduction Reactions."
6. Dr. Werner von Bolton, Charlottenberg.

The following Papers have also been accepted, but dates and times for reading them have not yet been planned :—

1. O. S. Burns, Boston, "Colloidal Substances."
2. Prof. Vogel, Berlin, "Impurities of Acetylene Gas."
3. Dr. Saekur, Berlin, "The Design and Erection of 'Galvanischen Anstalten.'"
4. Dr. Lob, Bonn, "The Influence of the Cathode Material in the Reduction of Nitro-benzol."
5. C. Ponti, Milan, "The Electrolysis of Water."
6. Direktor H. Gall, Paris, "The Sampling and Testing of Calcium Carbide and Acetylene Gas."

From the above list it will be seen that about one-half of the papers to be presented to Section X. of the International Congress will deal with electro-chemical or electro-metallurgical subjects, and abstracts of the more important of these, and of the discussions upon them, will be given in succeeding issues of the ELECTRICAL REVIEW.

NOTES.

Hackney Clinkers.—Hackney Borough Council has had under consideration a proposal from a Mr. Cotching, of Walthamstow, to lease certain land adjoining the Millfields electricity works for the purpose of establishing a manufactory where from the residual clinker at the destructor he will make bricks, slabs, &c. The necessary electricity for driving his various machines would be obtained from the Millfields electricity works. The terms upon which the arrangement was to be entered into were placed before the Council at last week's meeting, but presumably 'Ackney Councillors were possessed of the 'oliday spirit, or else they prefer to leave refuse destructor matters alone this weather, for we learn that the question had to be shelved by reason of a "count out." This is a pity, for we should have thought that Hackney Councillors would have been very ready to adopt a scheme which would be of some assistance—however small—in reducing the loss at present being incurred on the electric light and refuse undertaking. It is said that the saving effected would be about £2,000 per annum.

The Eton Fire.—The lamentable fire at Eton has once more brought into prominence the urgent necessity for the adoption of more enlightened measures in the protection of large public buildings from the ravages of fire. There were statements made which pointed to the belief that the disaster was caused through the fusion of the electric light wires; but it is easy to lay the blame in this direction when there is nothing else to show directly how a fire originates. It is satisfactory that, at the inquest, expert evidence was produced amply proving that there was absolutely no foundation for the suggestion that there was any electrical fusion. The sad affair will have to be added to the already lengthy list of conflagrations the source of which must remain a mystery. But whatever the cause may have been, the event drives home once more the sad lessons of Queen Victoria Street and Colney Hatch. We must continue to press for the adoption of the most modern means for detecting and limiting fires in their earlier stages, for giving instantaneous and automatic alarms, and for facilitating speedy escape from burning buildings. The bars will be removed from the Eton windows now, on the familiar lines of locking the stable-door after the steed has been stolen. The jury, in returning its verdict of "Death from suffocation," added a rider strongly recommending that electrical communication with the engine-house be adopted for every boarding-house in the college.

The Trade Disputes Commission.—The following are the members of the Royal Commission which has been appointed to inquire into the subject of trade disputes and trade combinations and as to the law affecting them, and to report on the law applicable to the same and the effect of any modifications thereof:—The Right Hon. A. Graham Murray, K.C., M.P., Lord Advocate for Scotland (chairman); Sir William Lewis, Bart.; Sir Godfrey Lushington, G.C.M.G., K.C.B.; Mr. Arthur Cohen, K.C.; and Mr. Sidney Webb. Mr. Hartley B. N. Mothersole, M.A., Barrister-at-Law, has been appointed secretary to the Commission.

Obituary.—We regret to learn that Dr. Andrew Ainslie Common, LL.D., F.R.S., the astronomer, died suddenly at his residence, Eaton Rise, Ealing, on Tuesday, whilst writing. Deceased complained of neuralgia on Sunday night, but otherwise had seemed quite well. Dr. Common, who was born at Newcastle in 1841, was a past President of the Royal Astronomical Society. His claim to distinction rested rather upon his achievements in making and improving astronomical instruments than upon observatory work, though at his private observatory at Ealing important observations were at one time taken. In the early days of electric lighting, nearly a quarter of a century ago, Dr. Common was interested in several meritorious inventions, and later he was known as a director of the British Aluminium Co.

Personal.—Mr. W. P. J. Fawcus has resigned his seat on the board of Messrs. W. T. Glover & Co., Ltd., cable-makers of Manchester, and has accepted a seat on the board of Messrs. Crossley Bros., gas engine builders, of Manchester. He has also moved his office from 78, King Street, and has opened offices at 4, Queen Victoria Street, E.C., and at 14, College Land, St. Mary's Street, Manchester.

The King has appointed the following Companions of the Imperial Service Order and granted the Imperial Service Medal:—Robert Townley Scott, Esq., Secretary, Postal and Telegraph Department, Commonwealth of Australia; Richard A. Sholl, Esq., Deputy Postmaster-General and Superintendent of Telegraphs for the State of Western Australia; Benjamin Michael Duff, Esq., Secretary, General Post Office, Colony of the Cape of Good Hope; Henry Luttrell Moysey, Esq., Postmaster-General and Director of Telegraphs of the Island of Ceylon.

Burton-on-Trent T.C. on May 28th appointed Mr. P. J. Pringle, of London, as electrical engineer and tramway manager.

Lowestoft T.C. has appointed Mr. J. A. Roberts as chief inspector of the electric tramways.

Sir William Ramsay, Professor of Chemistry at University College, London, has been elected member of the Austrian Academy of Sciences.

M. A. Heyland has removed from Rue du Marteau to 33, Rue de la Pépinière, Brussels.

Mr. Albert W. Hyde, manager of the Otley district of the National Telephone Co., has been promoted to the managership of the Stockton-on-Tees district.

Mr. John McMillan was presented with a silver tea service by his colleagues of the Electric Construction Co., Ltd., on the occasion of his marriage on June 3rd.

Oldham Electricity Works.—The new electric power station at Oldham is to be formally opened on June 15th. It was intended to follow the ceremony with a banquet, for which about 100 invitations have been sent out. At the meeting of the Town Council on Wednesday night, Councillor Strain asked what it was intended to spend on the banquet? Alderman Brierley moved an amendment to the minutes of the Electricity Committee to the effect that all arrangements made for the proposed banquet be cancelled by the Committee. Seeing the state of trade, he urged that such an affair was out of place at this time.—Councillor Schofield seconded.—Alderman Harrop (chairman of the Electricity Committee) objected with much heat to the amendment. He quoted previous Corporation celebrations, and said that for years the Committee had toiled with the scheme, and reserved any celebration until its completion.—The amendment was carried, Alderman Harrop alone dissenting.

Change of Address.—Messrs. Gabriel & Angenault notify that their address is now 15, Victoria Street, S.W.

"The Fountain of Youth."—When the question is asked why electricity applied from a physician's battery will not do just as much good as when the wonderful appliance called "Electro-Vigour" is worn, the following reply is given:—

"Because that current is too severe. You know how sensitive the nerves of your eye are. Well, the nerves of your stomach are nearly as sensitive. Just imagine sending a current from a battery into your eye and you can appreciate how severe the current from a battery must be upon the delicate nerves of the stomach.

"But a physician can apply the current in a very mild form from his battery.

"Yes, but not as mild as it should be to do any good. To derive actual benefit the nerve cells must take up the electric life and keep it. The mildest form of battery current is too severe to permit that."

Every electrician is aware that we can reduce the current from a battery to the most infinitesimal amount—to what we please in fact—therefore, this balderdash is absolutely misleading to the man in the street, and ought to be put down with a firm hand. But when papers like the *Daily Telegraph* publish, as it did on Whitsun Monday, a full page advertisement of quasi-scientific jargon, the result of an interview with "the great American specialist in electro-therapeutics," how is it possible to guard poor suffering humanity from the men who benefit by their misfortunes!

Only a fortnight ago we alluded to the *Standard's* denunciation of various shams with a pseudo-scientific terminology, while in the same issue its advertisement pages were drawing attention to the very "fads of the day" it denounced in its leading article! We are glad to see that several of our technical contemporaries have been with us in this crusade, but what are the medical journals about? Will they, as in the electropathic belt matter, leave the Electrical Press to fight the battle which, in the interests of the profession they are supposed to represent, they should have the courage to begin and win?

Tramways and Electrolysis.—Some statements have been appearing in the Press both at Leeds and in London respecting alleged discoveries of electrolytic corrosion of gas pipes and electric light cables caused by Leeds electric trolley currents. We refrain from making any comments upon the matter in the absence of complete details of the facts. A special committee of the Gas Committee has been appointed to go into the question, to confer with the Electric Lighting and Tramways Committees, and, if necessary, to engage an electrical expert to assist in its deliberations. If, therefore, there should happen to be any truth in the reports, we shall hear a great deal more on the point before very long.

Appointments Vacant.—Shift engineer for the Sheffield tramway power station (£120, rising to £180); meter inspector for Tunbridge Wells. See "Official Notices" to-day.

Our Telegraph Guests.—Two hundred delegates to the International Telegraph Conference were on 2nd inst. conducted over the Portsmouth Dockyard, Whale Island, and the *Victory*.

Physical Society.—At the meeting held on May 22nd, Dr. R. T. Glazebrook, F.R.S., in the chair, Mr. J. Stöttner gave an "Exhibition of Nernst Lamps, showing their development from the experimental form up to the most recent types." Mr. Stöttner commenced by giving a short account of the history of the Nernst lamp, and explained briefly the principle of its action. The oxides used for the glowers are thoria, zirconia, and other rare earths thereto related, such as oxides of yttrium and cerium. A paste of these is formed, and small rods or tubes are pressed through a suitable nozzle. These are hardened and cut into small lengths, and practically the principal part of the lamp is then finished. Several of these rods were passed round for the inspection of Fellows. The chief difficulty in the practical lamp is in the design of a durable automatic heater to heat the filament up to conducting point. A number of automatic arrangements which have been designed for disconnecting the heater were shown. Another important part of a Nernst lamp is the bolstering resistance, which in its final development consists of a thin iron wire sealed in a glass bulb filled with hydrogen gas. If a lamp is used without a bolstering resistance, as soon as a certain critical potential is reached the current increases, at first slowly, and then quicker and quicker, the potential remaining constant until the lamp burns itself out. This phenomenon was shown experimentally. Various forms of lamp were exhibited. One with two glowers and one heater overcomes the difficulty of thick glowers. A projection lamp was shown with three glowers in parallel, requiring 300 watts. The glowers in this case were heated artificially. Mr. Stöttner also exhibited and described a pole-finder for use with lamps using direct current.

The chairman said he would like to see details of the life and economy of these lamps under various conditions. The lamp was in its infancy, and probably even more satisfactory lamps would be forthcoming.

The Council are considering the advisability of altering the place and time of meeting of the Society. They hope to arrange for holding meetings on the second and fourth Fridays of the month alternately in the afternoon and the evening at the Royal College of Science, South Kensington, thus allowing arrangements to be made for the convenience both of Fellows who are engaged in teaching and those whose duties will not permit of their attendance at afternoon meetings. It is the hope of the Council that the conveniences and the equipment available when the Society meets in a Physical Laboratory will encourage Fellows to illustrate their papers by experiments, and thus add to the interest of the meetings. The Council have also under consideration the formation of a Student Class in the Society. This matter will shortly be brought forward at a special general meeting.

Institution of Electrical Engineers. — Dublin Section.—The annual general meeting was held on the 29th ult. in the Royal College of Science, Mr. A. E. Porte presiding. A paper entitled "The Electric Generating Station of the Future" was read by Mr. A. W. Whieldon. Its gist was that inasmuch as our coal supply was limited, the electrical distribution of power became a question of national importance. In the near future economy would demand the linking together of scattered installations in business centres into a concrete whole, which centralisation would prevent wastage. The paper also dealt with the probable life of our coal supply, and with methods for economising in home consumption. A paper on "The Moving Coil of the Ballistic Galvanometer," by Messrs. M. Donegan and W. G. Smith was read, but the discussion was postponed.

Where the Gutta-Percha Comes From. — The following is an extract from the *Nieuwe Rotterdamsche Courant*, of May 26th, 1903:—"The cable between the islands of Bali and the Celebes, along which all telegrams to and from Macassar and the Moluccas islands are despatched, is at last again in good order, after having been in a very bad condition during more than a month, on account of defects in the isolation. The working of this cable under normal circumstances, requires much skill and attention owing to the employment of old-fashioned mirror apparatus, and now it is almost impossible to exchange messages. Nevertheless, the telegraphists working this cable do their utmost to continue as much as possible the communication, notwithstanding great loss of current, by observing with the greatest attention, and with a patience equal to Job's, the microscopically small signals received, and as the working is very slow, the telegraph clerks are obliged to sacrifice therefore a great part of their free time. The arrival of a cable ship is expected from Singapore, to effect the necessary repairs of this cable connection."

THE CENTRAL STATION ENGINEER.

The staff and employés of the Paisley Corporation Electricity Department met on Friday evening last in the Commercial Hotel, under the chairmanship of Mr. Poole, to pay a tribute of respect to Mr. John McFadyen and Mr. C. E. H. Parkinson. Mr. McFadyen leaves the works to commence an engineering business for himself; Mr. Parkinson is a son of the resident electrical engineer and leaves the town to gain experience with Messrs. Davey, Paxman & Co., engineers, Colchester. During the evening, Mr. Walker, on behalf of the subscribers, presented Mr. McFadyen with a beautiful marble clock. He was sure that Mr. McFadyen was well fitted for the business which he was about to take up. Mr. McFadyen suitably replied. Mr. B. B. Granger was called upon to perform a similar duty to Mr. C. E. H. Parkinson, whom he asked to accept an Elgin gold watch. Mr. Parkinson thanked all the staff for so kindly remembering him. A most enjoyable evening with songs, recitations, and selections on the bagpipes by Mr. Townley, jun., was brought to a close with the singing of Auld Lang Syne.

Southampton T.C. has increased the salary of Mr. H. L. Miller, mains superintendent, from £170 to £190 per annum.

Ilford U.D.C. has increased the salary of Mr. A. H. Shaw, electrical engineer, from £350 to £450 per annum.

Mr. McKenna, the assistant engineer at the Peterborough Corporation electricity works, has been presented with a timepiece by the staff and employés on leaving to take an appointment at Bray, in Ireland.

Mr. W. L. Lackie, chief assistant engineer, and Mr. R. B. Maccall, chief clerk in the electricity department at Glasgow, have had their salaries increased, the former from £425 to £475, and the latter from £225 to £275.

On May 27th, Mr. T. F. Aikin, surveyor to the Stalybridge, Hyde, Mossley and Dukinfield Tramway and Electricity Board, was presented by his colleagues with a gold mounted walking stick, suitably engraved, on his leaving the Stalybridge office to join the permanent way staff of Messrs. Dick, Kerr & Co., for their Wakefield contract.

Mr. Arthur G. Shearer, of Cork Electric Lighting and Tramways Co., Ltd., has been appointed assistant tramways engineer to Reading Corporation.

The Stoke-on-Trent T.C., on May 28th, decided to increase the salary of Mr. Tiddeman, electrical engineer, by £50 per annum.

Mr. E. T. Goslin, electrical engineer to the Glasgow Corporation Tramways, has been granted an increase of £50 per annum.

Shipley Council has granted a honorarium of £25 to Mr. S. D. Schofield, electrical engineer, in respect of special work carried out by him in the electricity department.

NEW COMPANY REGISTERED.

Bee-Bee Electrical Engineering Co., Ltd. (77,518).—This company was registered on May 27th, with a capital of £500 in £1 shares, to carry on the business of electrical, mechanical and consulting engineers, suppliers of electricity and maintainers of electric lighting and power, &c. The first subscribers (each with one share) are:—H. G. D. Bennett, 37, Sister's Avenue, Clapham, S.W., theatrical proprietor; Mrs. F. L. Bennett, 37, Sister's Avenue, Clapham, S.W.; B. Brown, 8, Lullington Road, Anerley, S.E., manager; E. de H. Body, 66, Eccles Road, Clapham, S.W., assistant; E. V. Bertram, 39, Stormont Road, Clapham, S.W., electrical engineer; Mrs. E. L. Bertram, 39, Stormont Road, Clapham, S.W.; Miss N. Brown, 337, Coldharbour Lane, S.W.; and D. V. Levien, 14, Elgin Crescent, W., clerk. No initial public issue. Registered without articles of association. The first directors are E. V. Bertram and H. G. D. Bennett. Registered office, 272, Lavender Hill, S.W.

ELECTRICITY SUPPLY ACCOUNTS.

West Bromwich Municipal Electricity Supply.

The returns of this Corporation's electrical department illustrate in a forcible manner the advantages of a traction load, in this case, perhaps, supplemented to some extent by a growing power load, in effecting a reduction in works costs. The supply was commenced in May, 1901. In 1902 the department obtained the undoubtedly high figure of 4·48d. per unit works cost, and this has been reduced to 1·81d. per unit, in the past year.

The revenue has largely increased, and the department is this year able to show a considerable gross profit. The plant in this station consists of Parsons turbo-generators, the total capacity being 650 kw. The chief electrical engineer is Mr. J. H. Wray.

General Statement.

For year ending March 31st—		1902.	1903.	Inc.
Total capital expended		£28,166	£40,058	£11,892
Number of units sold		62,894	285,848	222,954
Equivalent number of 8-c.p. lamps connected		5,486	11,937	6,451
Maximum load in kilowatts ...		122	568	446
Number of public lamps		1	1	—
Revenue Account.	Gross revenue ...	£707	£2,930	£2,223
	„ expenditure ...	£1,175	£2,159	£984
	„ profit	—468	771	£1,239
Average price per unit sold ...		2·60d.	2·31d.	—·29d.

During the year the department obtained its first traction load, and of the 285,848 units sold, 105,947 units were for that purpose.

The average prices obtained during the two years were as follows:—1902, lighting only, 2·69d., lighting and power, 2·60d., average per unit sold, 2·60d.; 1903, lighting, 2·83d., power 1d. and traction 2d., average price per unit sold, 2·31d.

The prices charged are 4½d. to 2·1d. per unit, dependent on the number of hours' use per day; or on the maximum demand system, 4½d. per unit for 91 hours per quarter and 1½d. per unit after. Churches, &c., 3½d. per unit, power 1d. and tramways 2d.

Revenue Statement.

	1902.		1903.		
	Gross.	Per unit.	Gross.	Per unit.	Inc.
Sale of energy	£681	2·60d.	£2,756	2·31d.	—·29d.
Meter rents, &c. ...	26	·10d.	174	·16d.	+·06d.
Gross revenue ...	£707	2·70d.	£2,930	2·47d.	—·23d.

With the large increase in output the works costs show a great reduction on all the items; but particularly, as might be expected, in the direction of fuel and management. As the power load is making great strides, it is not too much to expect a further substantial reduction during the present year.

Working Expenses.

	1903.		1902.	
	Gross.	Per unit.	Per unit.	Inc.
Coal and cartage	£647	·51d.	·91d.	—·37d.
Oil, waste, water and engine-room stores	131	·11d.	·34d.	—·23d.
Salaries and wages incurred in generation and distribution	881	·32d.	·42d.	—·10d.
Repairs and maintenance of buildings, machinery, mains, and distributing plant	179	·15d.	·26d.	—·11d.
Works and distribution costs ..	£1,338	1·19d.	1·99d.	—·81d.
Rents, rates, taxes and insurance ..	362	·30d.	·38d.	—·08d.
Management expenses including salaries of engineer, secretary and clerical staff	382	·32d.	1·35d.	—1·03d.
General establishment charges, stationery, printing and law ..	77	·07d.	·82d.	—·75d.
Total costs	£2,159	1·81d.	4·48d.	—2·67d.

Financially, the department is on the upward grade—this being only the second year, and the adverse balance for the year amounting to £436, as against £1,403 in the previous year.

Profit Statement.

	1902.	1903.
Interest and sinking fund on loans ...	£935	£1,207
Balance for year...	—1,403	—436
Gross profit	£468	£771

South Shields Municipal Electric Supply.

The returns for the past year's working of the South Shields Electrical Department bear evidence of the increasing popularity of the supply in that town, the output having increased by 17 per cent. and the revenue by 15 per cent.

As this has been accompanied by a decrease in the total costs per unit of 10 per cent., a considerable surplus remains on the year's working.

The progress of the undertaking during the past four years will be gathered from the following figures:—

Year.	No. of units sold.	Number of 8-c.p. lamps connected.	Number of public lamps.	Total cost per unit sold.	Average revenue per unit sold.
1900	501,839	26,004	76	1·89d.	3·72d.
1901	755,826	35,025	191	1·88d.	3·70d.
1902	935,646	41,680	365	1·44d.	3·24d.
1903	1,148,965	47,674	402	1·26d.	3·20d.

The slight increase in capital expenditure is due to mains extensions, the capacity of the generating plant being the same as in the previous year. Mr. J. H. Cawthra is the borough electrical engineer.

General Statement.

For year ending March 31st—	1902.	1903.	Inc.
Total capital expended ...	£138,888	£145,815	£6,927
Number of units sold	985,646	1,148,965	163,319
Equivalent number of 8-c.p. lamps	41,689	47,674	5,994
Number of public lamps ...	83 arcs. 282 incd.	88 arcs. 314 incd.	5 arcs. 32 incd.
Maximum load in kw.	767	829	62
Revenue Account. Gross revenue ...	£13,664	£15,717	£2,053
Revenue Account. Gross expenditure	£5,914	£6,118	£204
Revenue Account. Gross profit ...	£7,750	£9,599	£1,849
Average price per unit sold ...	3·24d.	3·20d.	—·04d.

Of the total 1,148,965 units sold, private consumers took 759,600, at an average price of 3·9d. per unit; and public lamps took 389,265, at an average price of 1·4d. per unit. The prices charged are 7d. per unit for the first hour, and 2d. after, on the maximum demand system, or a flat rate of 5d. per unit. Power at 2d. per unit. Public arc lamps, £22 10s. per annum each; incandescents from 1s. to 2s. per lamp per week.

Revenue Account.

	Gross.	Per unit.	Gross.	Per unit.	Inc.
Sale of energy ...	£13,329	3·24d.	£15,331	3·20d.	—·04d.
Meter rents, &c. ...	400	·10d.	387	·08d.	—·02d.
Gross revenue	£13,729	3·34d.	£15,718	3·28d.	—·06d.

Working expenses have dropped very much within the past year or two, and now stand at 1·26d. per unit. All the items show a reduction on the previous year, with the exception of rates, which are up ·04d. per unit.

Working Expenses.

	1902.		1903.	
	Gross.	Per unit.	Gross.	Per unit.	Inc.
Coal	£1,787	·43d.	£1,778	·37d.	—·06d.
Oil, waste, water, and engine room stores	183	·04d.	180	·03d.	—·01d.
Salaries and wages incurred in generation and distribution, and attending public lamps	1,574	·38d.	1,382	·28d.	—·10d.
Repairs and maintenance of buildings, machinery, mains and public lighting..	853	·22d.	861	·19d.	—·03d.
Generating and distribution costs ..	£4,397	1·07d.	£4,201	·87d.	—·20d.
Rents, rates and taxes	198	·05d.	467	·09d.	·04d.
Management expenses, salaries of engineer and secretary and clerical staff	1,324	·32d.	1,426	·30d.	—·02d.
Total cost	£5,914	1·44d.	£6,094	1·26d.	—·18d.

As a result of the year's work a gross profit of £9,599 has been earned—being an increase of £1,849 on the previous year, after providing for financial charges—and a balance of £1,232 remains. During the year a reserve fund has been created, and some £2,700 of the accrued profits set aside, which will, however, be reduced by £400, for legal expenses recently incurred.

Profit Statement.

	1902.	1903.	Inc.
Interest on loans	£4,018	£4,465	£447
Sinking fund	3,138	3,902	764
Balance	594	1,232	638
Gross profit	£7,750	£9,599	£1,849

CITY NOTES.

Callender's Cable and Construction Co.

The annual meeting of the shareholders of this company was held on Thursday of last week at Hamilton House, Victoria Embankment, Mr. Henry Drake presiding.

The Chairman, in proposing the adoption of the report, said the board were pleased to meet the shareholders, but the pleasure was tempered with regret that the profits were not quite so large as they were last year. If they looked into the matter, however, he thought they would see that there was no cause for dissatisfaction. They had had a very difficult year to get through, and he thought it reflected the greatest credit upon their able managing director that they had been able to produce such results as they were now showing. Looking through the accounts for the past seven years he found that the profits they had made in that period had amounted to £316,500, which was an average of £45,000 a year. In a bad year, which he considered the past year to have been, they had only fallen £5,000 short of the average, and, therefore, he did not think they had any reason to complain when they remembered that the company was a manufacturing concern. There was an important matter he wished to call their attention to, viz., the valuation that had been made of the factory, machinery and plant at Erith by Messrs. Bramwell & Harris, who were very eminent authorities on engineering matters; and they could not have a more reliable certificate than they had received from that firm. After allowing for depreciation they valued the premises at £300,884, which was £19,000 more than the works stood at in their books, and that was without allowing a single farthing for goodwill or patents. They would see, therefore, that after everything had been allowed for depreciation, they had got £100,000 carried to reserve. They were carrying £19,112 to the credit of the machinery renewal account, which, with £6,000 already carried to that account, made a total of £25,112, and they proposed to carry forward £24,480 to next year. Therefore, with the reserve, the machinery renewal account and the money they were carrying forward, they were practically £150,000 to the good over and above the profits which they had divided. He thought the shareholders would agree that they were producing a very healthy statement of

accounts. As stated in the report, the reason for the falling off in profits was simply because there had not been so much work to do, and consequently everybody had been very keen to get it, and therefore it had not been so profitable. The works, at the present time, were fully employed, and he hoped they would continue so to the end of the year; and he trusted that next year they would be able to show something quite approaching the profits of former years. Regarding the issue of debenture stock last year, it might be interesting to know that they offered £110,000 to the public, and they had applications for £231,000, which showed how well the company was thought of by the outside public. He had to mention, with great regret, the retirement of Mr. Callender and Mr. McEwen. Mr. Callender was the founder of the business, and had naturally been associated with it from its earliest times, and he could assure them that they would part with him from the board with the very greatest regret. But he was not well enough to attend the board meetings; and, although he was in constant communication with Mr. T. O. Callender, and frequently gave him most valuable advice, yet he was not capable of attending the meetings, and had, therefore, resigned. Naturally he was very reluctant to sever his connection with the company, and it had been suggested that he should be appointed a special director. The appointment would entail no expense upon the company, because he would simply share in the remuneration of the board as it stood at present. As regarded Mr. McEwen, he also was one of the original directors, and, as an old friend, they were exceedingly sorry to lose him. However, he wished to retire, and he believed he was advised by his doctor that he ought to. His son had been appointed in his place, and was able to give them most valuable assistance from his experience in commercial matters. Sir David Evans had been appointed to fill the vacancy on the board caused by the retirement of Mr. Callender.

Lieut.-Colonel G. A. Elliot seconded the motion.

Mr. T. O. Callender, the managing director, made his annual statement regarding the progress and prospects of the business. He said that immediately after the conclusion of the war in South Africa a considerable falling off took place in the municipal work, upon which the company mainly depended for its business. The reason for that was probably due to the fact that corporations found a difficulty in raising money on advantageous terms. The future of the company's business seemed now to be elsewhere than in town lighting, and if the expectations held out by several of the electric power companies were realised, there would be seen in this country in the next few years as great a change in the manufacturing conditions of England, owing to the use of electricity, as was experienced when steam traction was introduced.

The report was then adopted.

Subsequently a motion was carried appointing Mr. W. O. Callender a special director.

Belliss & Morcom, Ltd.

The report for the year ended March 31st last states that the profits for the year, after making ample provision for depreciation, &c., and after payment of the preference dividend, amount to the sum of £33,324. The directors have already distributed an interim dividend on the ordinary shares at the rate of 5 per cent. per annum; they now propose to pay a further dividend, making 12½ per cent. for the year; to place £10,000 to the general reserve fund, and to carry forward the balance, together with the amount brought forward from the preceding year.

Lisbon Electric Tramways, Ltd.

Colonel Sir C. Euan Smith presided at the meeting held at Winchester House on 28th ult. In moving the adoption of the report, the chairman said that it was owing mainly to the ability, energy and zeal of Mr. W. B. Rommel, the late general manager and chief construction engineer, that the construction works were finished, not only well within the allotted time, and well within the estimates, but also in an exceptionally complete and satisfactory manner. Since then the success of their daily working had testified to the reality of the want which the tramways were intended to supply and to the efficiency of the supervision which watched over their birth.

The report was adopted, and the retiring directors and auditors were re-elected

Mexico Electric Tramways, Ltd.

The meeting held on 28th ult. was presided over by Sir C. Euan Smith, who moved the adoption of the report already abstracted in our columns. He said that the tramways had made most satisfactory progress both as to their earning and carrying capacities. They carried 5,000,000 more passengers last year than in the year before. The construction account had now been closed.

The motion was carried unanimously.

Prospectus.

From our advertisement pages to-day, it will be seen that the Acetylene Gas and Electric Smelting Co. is offering for public subscription £10,000 first mortgage 5 per cent. debenture stock; 12,500 £1 preferred ordinary shares; and 5,500 £1 deferred shares. The business carried on by the company primarily is calcium carbide manufacture. The issue is made for the purpose of acquiring mills now occupied by the company, and water rights in connection therewith, the patent rights of an electric furnace, and for putting down additional plant at the works. The estimated cost of the mill, water rights, land and machinery is £17,000, and £6,000 is to be paid for the purchase of the furnace patent rights. Mr. Arthur Parker, the inventor of the furnace (R. & A. Parker, Ltd., electrical engineers, Chorley), is to join the board after allotment, and is to be managing director.

Stock Exchange Notice.—The Committee has ordered the following to be quoted in the Official List:—Urban Electric Supply Co., Ltd.—4,000 ordinary shares of £5 each, fully paid, Nos. 1 to 7 and 30,008 to 34,000.

City of Wellington Electric Light and Power Co.—The allotment letters for the issue of the 5 per cent. first debentures were posted last week.

STOCKS AND SHARES.

Wednesday Evening.

Holiday influences made but little difference to the quietude of Stock Exchange markets when the House re-assembled after Whitsun, and the volume of trade is smaller than ever. There is vague talk of a further reduction in the Bank Rate, but conditions in Lombard Street do not seem to point to any speedy return to 3 per cent. The slackness of summer shows signs of making its annual appearance, and almost the only sensational scene in the Stock Exchange drama is that furnished by a series of violent spasms in the Yankee Market.

Up to the present, the severe fall in American Railroad shares has not had its commonly depressing effect upon the securities of the various Anglo-American cable companies. Even Anglo-American Deferred is steady, and the Preferred stock, of which there is none too much about, is rather inclined to harden, although quotably the stock remains unchanged. Nor are Submarine Cables Trust certificates affected. Globe Telegraph and Trust shares of both classes have recovered their dividend. A slight feature in this section is the reviving tendency for West Indian descriptions. Cuba Telegraph Preference are advancing into favour, and mark a rise of £1, and West India and Panama First Preference have been picked up now that the price is *ex* 8s. on account of arrears. The Eastern section displays a rise of a point in Eastern Ordinary and a drop of the same amount in the Preference stock, "Chinas" being unchanged.

Callenders have fallen 10s., the recent report being responsible for a few selling orders, and the 20 per cent. of 1901 is still being regretted. It is understood, however, that the company is now doing well and securing its full share of a goodly number of contracts that are going about. Naturally, when a £5 share gets up to about 13, and in a limited market, a very few orders either way suffice to move the price. General Electrics have relapsed to par.

The electricity supply section is motionless as the river at Henley on a hot afternoon in June. Only one of the Ordinary shares in our list has varied, Citys being ¼ up, and one or two of the Debentures are slightly better upon quiet investment buying. By degrees all the best class stock in this market is becoming absorbed, and the cry goes up for more. The new share issues by the Edmundson's and Charing Cross Electric Cos. have not yet made their appearance. We may mention incidentally that a preliminary prospectus is being drafted by an important manufacturing company, which will shortly be offering its shareholders more capital.

Dead for a long time past, Nernst Electric Preference have developed a little life this week, and are changing hands between four and five shillings. Kalgoorlie Electric Preference have eased off to 10s. A final call of £2 per share has made South Wales Power Distribution fully paid, and the nominal price is about 10s. discount. If we remember aright, the underwriters of this issue received 10s. a share commission.

The enormous traffic carried by the London United Tramways Co. on the holidays has fractionally strengthened the price of the Preference shares, which stand at 11⅞, and the Ordinary are also harder at 22½. The Debenture stock can be negotiated in the neighbourhood of 107. British Electric Tractions are firm, and there is a fair amount of business doing in them; but beyond these two undertakings the tramway department is very listless. Nor do the electrical railway stocks show any change, although City and South London Ordinary is receiving a certain degree of attention; and it may be that with the approach of dividend-time the electrical securities may advance here and there. Districts at 39 are dull, and Metropolitan keeps about the round 90. Great Northern and City Preferred "A" shares at 8½, and Great Northern and Piccadilly Ordinary at 10, are both steady and neglected.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900	1901.	1902.	Closing Quotations May 27th.	Closing Quotations June 3rd.	Business done week ended June 3rd, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3¼	2¼— 3¼	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3⅛%	61s.	60/6	47 — 50	47 — 50	47	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	89 — 91	89 — 91	90½	90
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8 — 8½	8 — 8½	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4½— 5½	4½— 5½	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	155 —165	155 —165	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 92	89 — 92	90⅜	89½
16,000	Cuba Telegraph	10	4½%	4 %	6½%	6½— 7⅛	6½— 7⅛	7⅛	..
6,000	Do. 10 % Pref.	10	..	..	..	14 — 15	15 — 16	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	.. — ..	98 —102	..	..
60,710£	Direct United States Cable	20	3½%	3½%	..	9 — 10	9 — 10	9⅜	9½
92,800£	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	117 —122	118 —123	121	119
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	83 — 86	82 — 85	84½	83½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	104 —107	104 —107	106½	..
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	10½— 11⅛	10½— 11⅛	11⅛	10⅞
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 3,000	25	..	..	..	99 —102	101 —104 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8½— 9	8¾— 9	9⅛	..
180,042	Do. do. 6 % Pref.	10	..	..	..	11½— 12½	11½— 12½	11⅞	11⅝
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 24	22 — 24	23⅛	..
66,800£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	36 — 40	36 — 40	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	103½	103½
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	102 —104	103 —104	103½	102½
1,966,667	Do. do. Def. Stock	100	..	..	4½%	88 — 90	88 — 90	89	88½
15,000	Do. do. 3 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5⅛	..
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	98 —100	98 —100	98	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	102 —104	102 —104	102½	102½
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅛— ⅛	⅛— ⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7⅛	6½— 7⅛	..	..
3,808	Submarine Cables Trust	Cert.	..	..	..	108 —111	102 —112 xd	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5½— 6	5½— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5½	4½— 5½	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	105 —108	105 —108	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	92 — 97	92 — 97	95	..
267,980	Western Telegraph, Ltd., Nos. 1 to 267,980	10	7 %	7 %	..	11 — 12	11 — 12	11½	11
75,000£	Do. do. 5 % Debs. 2nd series, 1908	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	96 — 99	96 — 99	..	..
88,321	West India and Panama Telegraph	10	1%	..	..	⅛— ⅜	⅛— ⅜	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 7	6 — 6½	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3½— 4½	3½— 4½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	73 — 78	73 — 78	..	..
100,000	British Electric Traction	10	9 %	9 %	..	14 — 14½	14 — 14½	14⅛	14⅛
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12⅝	12 — 12⅝	12⅝	12½
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	124½	123½
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6¾— 7¼	6¾— 7¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	104	..
80,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	⅜— 1½	⅜— 1½	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	15/6 to 16/6	15/6 to 16/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾— 1½	¾— 1½	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1½— 1¾	1½— 1¾	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	89 — 94	89 — 94	..	..
35,000	Callender's Cable Construction shares	5	15 %	30 %	15 %	13 — 14	12½— 13½	13½	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5½— 6	5½— 6	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	108 —112	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	106 —109	106 —109	..	..
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	103 —106	103 —106	105	..
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	108 —111	108 —111	110	109½
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	71 — 73	71 — 73	72½	71½
85,000	Crompton & Co., Nos. 1 to 85,000	8	8 %	7½%	..	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	102 —106	102 —106	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,189	Do. do. "A" shares, 01—017,189	5	2½%	Nil	..	1½— 2⅜	1½— 2⅜	..	..
344,028£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 77	73 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1½— 2	1½— 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2½— 3	2½— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	10 — 10½	9⅜— 10½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	15 — 16	15 — 16	..	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5¼	5 — 5¼	5¼	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	110	109½
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19 — 20	19 — 20	19½	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	103	..
97,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5¾— 6	5¾— 6	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 11	10½— 11	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	33 — 36	33 — 36	35	33½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	99 —102	99 —102	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/- —2/-.
National Electric Free Wiring, 14/- —16/-.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14½—14¾.
Do. do. Pref (£10 pd.), 10—10⅜.

Bank rate of discount 3½ per cent. (May 21st, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations May 27th.	Closing Quotations June 3rd.	Business done week ended June 3rd, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord... ..	£ 1	..	..	..	5/8 — 7/8	5/8 — 7/8	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10¾ — 11	10¼ — 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼ — 10¾	10¼ — 10¾	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	9⅛
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5¾ — 6	5¾ — 6	5⅞	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4¾ — 5¼	4¾ — 5¼	..	..
262,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	106 —108	105 —107	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	5¾%	4 %	4½%	6 — 6¼	6 — 6¼	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —112	109 —112	110⅞	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	0 %	5 %	5 %	11¼ — 11⅝	11¼ — 12	11⅝	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	13⅞	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	123 —128	123 —128	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	103 —106	104 —107	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000.	10	4 %	4 %	4 %	8 — 9	8 — 9	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000.	10	..	..	..	12 — 13	12 — 13	..	..
400,000£	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red ..	..	..	..	..	110 —113	111 —114	111¼	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6⅞ — 7¼	6⅞ — 7¼	6 15/16	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6¼	6 — 6¼	6 15/16	6¼
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	107 —110	107 —110	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	11 — 12	11 — 12	11⅝	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	100 —103	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2⅛ — 2⅜	2⅛ — 2⅜	2⅛	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅜ — 6	5⅜ — 6	5⅜	5 11/16
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —103	100 —103	101½	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6¼%	7½%	17½ — 18½	17½ — 18½	18	17⅝
220,000£	Do. do. 4½% 1st Mort. Deb. Stock ..	..	..	..	..	110 —115	110 —115	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red ..	Stock	..	..	..	98 —101	98 —101	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	14 — 15	14 — 15	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15½ — 16½	15½ — 16½	..	..
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	5	..	..	..	8½ — 9⅛	8½ — 9½	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	99 —102	99 —102	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3½	3 — 3½	..	..
50,000£	Do. do. 4% Deb.	100	..	..	..	88 — 93	88 — 93	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3⅛ — 3⅜	3⅛ — 3⅜	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5⅛	5 — 5⅛	5⅛	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	5⅛	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	..	..
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛	6	..

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, June 3rd.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£21	..
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	3d.	..
a	,, Caustic (75/80%)	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	125/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 5	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	,, Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£43 to £145	..
c	Brass (rolled metal 2" to 12") basis	per lb.	7¼d.	..
c	,, Tube (brazed)	per lb.	9½d.	..
c	,, ,, (solid drawn).. ..	per lb.	7¾d.	..
c	,, Wire, basis..	per lb.	7½d.	..
c	Copper Tubes (brazed)	per lb.	9½d.	..
c	,, ,, (solid drawn) ..	per lb.	9½d.	..
g	Copper Bars (best selected ..	per ton	£75	..

	METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£75	..
g	,, Rod	per ton	£75	..
e	,, (Electrolytic) Bars ..	per ton	£70	£2 dec.
e	,, ,, Sheets ..	per ton	£81	£2 dec.
e	,, ,, Rod ..	per ton	£71 10	£2 dec.
e	,, ,, H.C. Wire	per lb.	8¼d.	¼d. dec.
f	Ebonite Rod	per lb.	8/-	..
f	,, Sheet	per lb.	5/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	3/10 to 3/10½	dec.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	45/8	1d. dec.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£11 15 to £11 17 6	2/6 dec.
g	,, ,, Sheet	per ton	£14 10	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 12 6	..
d	Mica (in original cases) small ..	per lb.	3d. to 1s.	..
d	,, ,, ,, medium	per lb.	2s. to 3/3	..
d	,, ,, ,, large ..	per lb.	3/6 to 7/3	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/1 to 1/4	..
p	,, ,, strip & sheet	per lb.	From 1/3	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	10d. to 1/-	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£130 to £131	£1 dec.
g	,, Foil	per lb.	1/6½	..
w	,, Wire, Nos. 1 to 16	per lb.	1/8	1d. dec.
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £65	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7¾d.	..
j	,, 6 lea. Flax	per lb.	5⅝d.	..
j	,, 8 ply 10 lbs. Russian ..	per lb.	4⅛d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4⅛d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* W. H. Hindley & Co.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	*	Total to date. £	*	Miles open.	*
	Aberdeen	May 30	1,184	+380	50,008	+13,128	—	—
	Birmingham	,, 30	5,324	+315	108,756	+ 5,542	—	—
	Bournemouth	,, 27	963	—	8,245	—	—	—
	Blackburn	,, 29	993	+152	7,868	+ 553	19½	+1½
	Blackpool	,, 28	618	—772	4,915	— 735	—	—
	Blackpool and Fleetwood	,, 30	424	—246	5,985	— 963	7¾	—
	Bolton	,, 31	1,963	+118	16,174	+ 2,114	25	—
	Bradford	,, 24	3,871	—197	27,589	+ 2,311	39	+2
	Brighton	,, 31	990	+226	21,012	—	6½	—
	Bristol	,, 29	5,692	+121c	—	—	23	—
	Burnley	,, 30	687	+145	—	—	—	—
	Barnsley District ..	,, 23	181	—	3,411	—	—	—
	Devonport	,, 22	417	— 51	8,317	+ 212	5	—
	Dudley—Stourbridge..	,, 22	779	—308	14,880	+ 925	18½	—
	Gateshead	,, 22	842	+ 15	16,610	+ 3,217	10½	+ ½
	Gravesend—Northfleet	,, 23	238	—	3,912	—	3½	—
	Greenock—Pt. Glasgow	,, 23	549	+ 37	9,349	+ 729	7½	—
	Hartlepool	,, 22	258	—108	4,615	+ 360	6½	+2
	Kidderminster	,, 23	112	—102	3,152	+ 6	4½	—
	Merthyr	,, 22	196	— 80	3,738	— 247	8	—
	Middleton	,, 22	299	— 75	5,365	+ 116	8½	—
	Oldham—Ashton ..	,, 23	552	— 54	10,911	+ 1,068	8	—
	Peterborough	,, 12	147	—	2,364	—	—	—
	Poole	,, 22	290	— 59	5,172	+ 748	8½	—
	Potteries	,, 23	1,633	— 85	30,862	+ 2,176	28½	—
	Rothesay..	,, 22	126	+ 37	1,321	+ 560	—	—
	Sheerness	,, 20	68	—	799	—	—	—
	Southport	,, 23	287	—196	5,088	+ 1,234	5½	—

	Locality.	Week ending	Receipts for the week. £	*	Total to date. £	*	Miles open.	*
	South Staffordshire ..	May 22	920	—175	15,484	+ 140	21¾	—¾
	Swansea	,, 22	463	—161	9,216	+ 589	5½	—
	Taunton	,, 23	57	— 31	1,079	— 68	1½	+1½
	Tynemouth	,, 22	473	—120	4,687	+ 400	3½	—
	Weston-super-Mare..	,, 20	78	—171	876	— 226	2½	+½
	Wolverhampton Dist.	,, 22	274	+ 54	7,326	+ 4,094	10½	+8
	Wrexham	,, 22	120	—	949	—	—	—
	Yorks. Woollen Dist. ..	,, 23	341	—	3,137	—	6	—
	Cardiff	,, 23	1,879	+152	13,621	+ 6,487	—	—
	Dover	,, 23	216	— 42	3,864	+ 44	3	—
	Dublin	,, 29	5,317	+546	95,311	+ 3,916	46	—
	East Ham	,, 30	712	+263	5,535	+ 1,709	5	+ ½
	Glasgow	,, 30	14,751	+2980	651,375	+38,569	65	+13
	Hull	,, 30	1,797	+ 91	15,832	+ 1,338	—	—
	Isle of Thanet	,, 30	583	+ 42	7,534	— 825	—	—
	Leeds	,, 30	5,776	+572	43,693	+ 2,959	—	—
	Liverpool	,, 28	11,416	+384	193,786	+10,400	101	+5
	Manchester	,, 16	11,529	+792	—	—	110	+85
	Newcastle	,, 30	3,322	+794	—	—	17	—
	Portsmouth	,, 30	1,777	+131	—	—	29	—
	Salford	,, 25	3,610	— 28	25,990	+ 6,496	—	—
	Southampton	,, 28	1,068	+116	—	—	—	—
	Sunderland	,, 24	1,262	—268	8,649	+ 70	20	—
	Central London Railway	,, 30	6,818	+ 4	153,713	+ 6,227	6	—
	Chatham & District Co.	,, 21	505	—	8,861	—	8½	—
	City and S. London Ry.	,, 31	2,733	—219	68,519	+ 3,098	6½	—
	Dublin and Lucan Rlwy.	,, 31	122	+ 34	2,098	— 2	—	—
	Liverpool Overhead Ry.	,, 31	1,663	+182	34,331	+ 2,963	6½	—

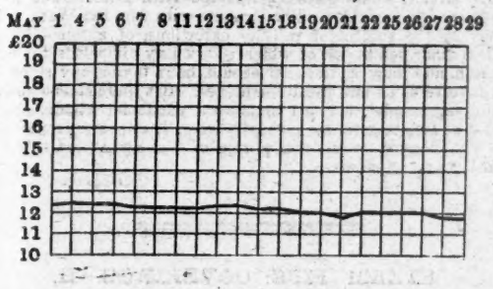
British Elec. Trac. Co.

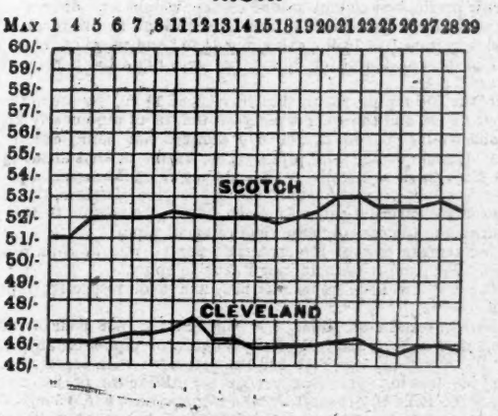
B.E.T. Co.

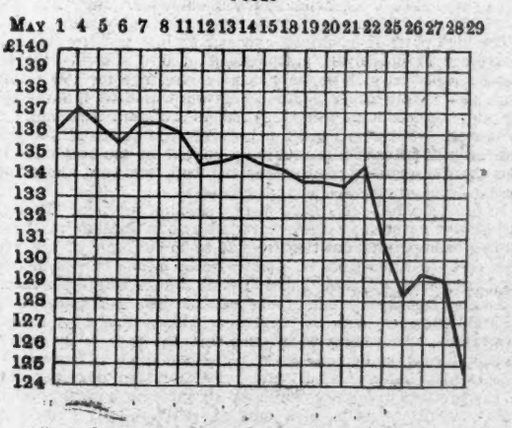
* Compared with the corresponding period of 1902.

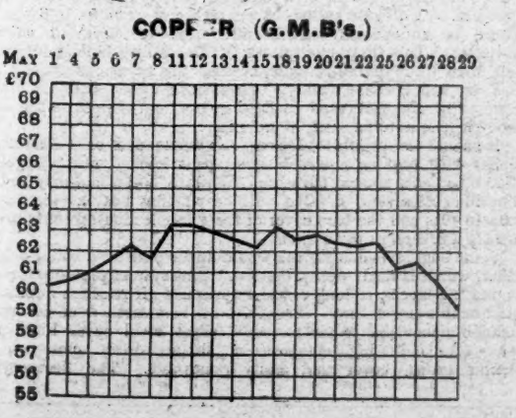
METAL MARKET.

Fluctuations in May.









FREE TRADE OR —?

[COMMUNICATED.]

Because one dishonest German has been found burgling the house of our daughter, are we to forbid our own house to our friends?

Such, in brief, is the position with which we are now face to face. Before the question of tariffs are discussed it may not be amiss to inquire into the origin of the present outcry for tariffs all round, and the existing international ill-feeling.

But first we may all admit that the head and front of the hubbub is Germany. Germany is the one nation named by Mr. Chamberlain against which he wishes Britain to be armed for reprisal. The commencement of the present question dates from the Kaiser's telegram to Kruger. It was then that German enmity to this country took form. It was from that date that many of us realised that there would be war in South Africa, and none of us felt surprise that Germany was against us in every form except in actually declared war. One of the results of that war was the intensifying of the Imperial feeling throughout the Empire, a phase exactly the opposite of what was hoped for and expected by Germany, between which country and ourselves there has been for several years one of those persistent and steady growths of mutual dislike and suspicion that is rarely extinguished without powder being burned. It was only because it was beyond her strength that Germany did not secure the very fullest advantages from our entanglements. If we recognise the origin of the tariff cry, we shall the more honestly be able to deal with the subject when really before us. Resentment!!! Such, no doubt, are our feelings. The whole world has had free entry into our markets. We naturally felt resentment when our misfortunes of one black week were hailed everywhere with the most ecstatic joy. Germany, in particular made herself most objectionable. Canada, following up the feelings which had been engendered by the war, decided to reduce her tariffs as against the Mother Country, whereupon Germany—it is always Germany—with an insolence unparalleled in international history, has given her mandate that Canada is no part of the British Empire, and shall not exercise a preference for her fellow citizens unless Germany also receives the same preference. Could impertinence go further? At present, being tied to a policy of free trade, our Government can do nothing to retaliate against Germany. But in order to enable us to retaliate, can it be necessary that we should upset all our fiscal policy? Surely a very simple little Act of Parliament would alone be necessary to put the power into the hands of the Government to retaliate promptly against any nation acting as Germany has done. The remedy would be short, sharp and decisive. We should declare a tariff war against such nation. We are all men of peace, and go to war only at the last moment if obliged to do so. This does not prove us not to be men of peace. So are we all free traders by upbringing and belief; yet there may be a time for war in regard to tariffs. This time has apparently come as regards Germany. Germany has got all we can give her, and is not content; henceforth give her less. But it seems folly to start a tariff war with others just because of one country. Did we commence with Germany, all the rest of Europe and America would dance with joy, and carefully refrain from following her stupid policy. German papers have threatened a real war should we take action on behalf of Canada. This threat need disturb us less than a little.

On the general question the *Daily Telegraph* gives the figures of our trade with the United States. They show that only 6½ per cent. of our exports go to the United States, and that 40 per cent. of the exports of the United States come here. Thus did we impose tariffs all round, there would be very little opportunity for American retaliation. If all our trade to Uncle Sam were cut off, it would not mean much to us. But it would mean very much to Uncle Sam of the West if his exports here were stopped. The western farmer would ask for better terms to be given to us so that he might not be ruined. On a general policy of tariffs we must tax food. If not, our agricultural interests would cry out that the manufacturing interests had taken the selfish place occupied by the agriculturists of 1840. Under free trade we have certainly prospered, and we do not believe with Mr. Chamberlain that protection would raise wages. It has not done so in other protected countries. Wages are said to be higher in the United States, but they do not afford better all round living and comfort than is enjoyed here, and, after all, there is free trade there over four million square miles. Tariff tinkering is a dangerous game. Can we tax food with any certainty of securing a sufficiency to eat? Can we tax raw materials and not injure our power to compete? Can we raise the price of food without either raising wages or injuring the health of our people? Can we tax manufactured goods only without an outcry from the unprotected agriculturist? Who would benefit by the tax on food? The farmer? We trow not! It would go into the pockets of the landlords and the land ring. We find it difficult to see a way to abolish free trade. But need we be bound hard and fast as in a vice? Are we to sit still while German insolence rages rampant round us and those of our household? This is a very different matter. We see no reason whatever for doing so. Parliament may well enact that there should be power to deal with such things as they come along. A sharp rap over the knuckles given to that bumptious nation would show that there were limits to our patience, and would do much to render the use of such powers unnecessary. We have hung up our weapons and nailed them to the wall, as we see old weapons in museums. It is the nails that ought to be drawn, so that the weapons can again be used. They will not inflict less dangerous wounds because they are a bit rusty.

The Colonial Secretary evidently had Germany prominently in

his mind; yet he talked chiefly of food, which we buy largely from America or Russia. There is very little we get from Germany that we cannot do without. Toys, fancy goods of a wide variety; much shoddy cloth; dye-stuffs made to dodge past tests rather than do good work; wines not fit to be named with those of France; cement loaded with gypsum to make it unsound to pass a slow setting test; electrical machinery, some of it good, much of it mediocre, and too flimsy to do well; badly-made machine tools, softer than soft American stuff; a good deal of semi-rotten steel, and the cheapest of hardware, carefully stamped "Sheffield," is sent to our Colonies to damage the reputation of English stuff. There is nothing dirty, mean or shoddy to which the German trader has not stooped to filch English trade.

Let the whole question of tariffs be inquired into, by all means, but let us be careful that, in our just resentment against Germany, we do not unnecessarily hamper our whole foreign trade.

One-fourth of our trade is with our Colonies. It is to be hoped this will grow. Do statistics show that our foreign trade grows less? May we not fairly ask the Colonies to accord us a preference? Are they acting even fairly towards us now in all respects? There are 10 millions of them who pay very little to the defence of the Empire. The Mother Country of 40 million people pays 80 millions sterling annually, of which 16 millions is the proportionate share of the Colonies. Is not this a full and fair *quid pro quo* for a preferential tariff?

We may at least join in the cry, "Hands off, Germany!" It would be affectation to deny the mutual ill-will that has followed on Germany's action for the past 10 years. She is our open and avowed enemy, as anyone may find if travelling there. Moreover, Germans boldly state that we shall do nothing, and that they can go on as they please. Whilst at the moment it is Germany that should be tackled, the case of the United States demands serious consideration, less because of her people as a whole than of individuals like Carnegie, Schwab, Morgan, and the crowd of dollar hunters who appear to aim at destroying our industry in detail. The iniquitous steel trust with its unprincipled methods is a menace to honest trading that is worked by a few hands. In the event of a break in the United States boom, what are we to do with the flood of cheap steel that will be dumped on us? Are we to deal by our own iron men as they have dealt by our agriculturists, for it is only now that the iron gander has begun to have sympathy with the agricultural goose? The tariff is on the face of it a huge question. Would it, after all, be so very huge if we plucked up courage and took up our disused arms and smote our enemies even as they have smitten us? It behoves all of us to ponder on it and think it out, so that when the time comes, we vote aright. But if it is to be a question on which the present Government is to ride to a further lease of power, then Heaven forbid!

We have an Empire three times the size of the United States. We have a white population as great, a coloured population twenty-fold greater. We produce twice the gold, have, in Africa and Egypt, better cotton lands, in Canada and Australia a larger wheat area, we grow better oranges, bananas and other fruits, and we ought to be able to raise all the meat we want. Probably the Empire contains more coal and iron. It grows more timber. We have as wide a range of climate. Our fisheries are more considerable. As a self-contained Empire we should show better results all round. Are we prepared to enjoy free trade over 12 million square miles, and with 400 million people, and to set up tariffs against the outer world? This is what the United States have done, but they have embraced less than 3 million square miles and only about 70 millions of a population at home and one-sided Free Trade with 40 millions in the British Isles.

Can the much greater resources of the more widely spread British Empire be brought into use so that we can live meantime? Food cannot much longer come to us from the United States. They will want it themselves.

Can we face the possibility of a shortage of food for a few years while our Colonies plough and sow and reap? A positive assurance of a tariff on food to be levied in, say, 1905, would find our Colonies perhaps in a position to fill the shortage. But could we buy? Trade is more or less barter. Gold does not pass. Will the Colonies take the £600,000,000 of goods which we now pay to foreign countries for the products we get from them—largely foods and luxuries?

How do we pay the United States for the £108,000,000 of stuff we buy from them? We send them only goods for £18,390,000, yet we don't pay the remainder in gold. The figures appear to show that the United States are useless to us as customers. Such questions cannot be answered in an off-hand manner, but the figures tend to make one careless of America's goodwill in the matter. Is such a feeling really justified? Resentment is natural. Still we continue to prosper. Many Americans find the "old and effete" country preferable to home. They deny this impeachment, of course, but still they remain here. The tariff question must be looked at as a whole and judged by its results. But it is clear that, as men, we cannot allow Germany's present insolence to endure. That, at least, must be met by retaliation.

Our Colonies would grant us preferences without a return preference. They must recognise the peculiar position in which we are placed. They cannot be so dull and stupid that they do not realise that we pay for their defence, and we must have food to fight on. But Germany's action against Canada is a thing outside, and must be stopped or replied to in the only way that a bully like Germany can understand.

Apart from the mere commercial view of tariffs, there is a further question. In event of war, how soon could we grow all the food we want? We may be sure that the calculating enemy would declare war when it was too late to sow spring wheat. This would leave us with a shortage until the following year, at least. So long as we grow so little food at home, there is a danger that no army can keep away. Hence the supreme folly of spending on an army the money that should be spent on the navy. Germany recognises our peculiar position, and is pressing on her navy to take advantage of it. It might be worth while to tax food and bring in an English land Bill, so as to meet the danger by making it pay the farmer to grow more food, and enabling others of us, who would like to do so, to get back to the land again. One cannot keep up the stamina of a great nation on town-bred weaklings. If the nation is to survive, it must be maintained in health. Only country-bred people are of any use in this respect. Tariffs and the tariff question are bound up with the national security in so many ways that a reconsideration may fairly be demanded.

On purely commercial lines it would pay us to abolish navy and army alike. It appears to us that the tariff question comes very much into the same category as the defences. These involve a disagreeable expense which we dare not avoid. It is usual to argue that free trade has ruined the farmer. This is the landlords' view; but if our farmers would wake up, like the Irish farmers, and secure fair rents, they could readily compete with the Far West. This brings up the subject of railway extortions, of automobiles and endless other points, all of which shows how difficult is the whole question, and how cautious we should be in taking any steps that will involve us in new fiscal intricacies. But there can be no harm in forging special weapons to meet a particular attack, and we should be free to retaliate promptly when it appears proper to do so. The Empire, to use the phrase of Tommy Atkins, is fed up with German impudence.

STEAM PIPE COVERINGS.—II.

A few particulars may be useful of the weight and dimensions of the coverings. Those on the 2-in. pipes varied in thickness before applying from ¼ to 1¼ in., averaging ¾ in., and weighed from 3·17 to 7·25 lbs. per length of 36 in., or, say, fully 4 lbs. per sq. ft. of external area.

On the 10-in. pipes the thickness averaged 1¼ in., the circumference about 43 in., and the weight per yard length of pipe nearly 21 lbs., or about 6 lbs. per sq. ft., the five samples not being exactly the same as those on the 2-in. pipes. The weight is thus about 4½ lbs. per 1 in. thick × 1 sq. ft. The amount of stuff to cover a pipe is, of course, not proportionate to the inside pipe diameter, the thickness of the covering being so much less in proportion to the pipe diameter in the case of large than of small pipes.

The average cost of the materials per ft. run of 2-in. pipes is barely 7½d., and it costs 2d. per ft. run to apply.

The cost for 10-in. pipes was 29d. and 2½d. respectively per ft. run.

With covered 2-in. pipes, the condensation per hour at 80 lbs. pressure averaged nearly 14 lbs. per sq. ft. of pipe area, and nearly 12 lbs. for 2-in. pipes at 150 lbs. pressure; with superior coverings the heat lost per hour per degree difference of temperature was 0·760 B.Th.U. per sq. ft. for the low pressure, and 0·539 B.Th.U. for high pressure pipes and coverings, the temperature difference being that between the steam and the outer air. Bare 2-in. pipes lost 3·081 and 3·336 units respectively at the two pressures.

The high pressure coverings exposed to low pressure steam lost an average of only 0·491 unit instead of 0·76, showing the commercial superiority of the more costly coverings for low pressure work also. Many other figures are given, which are interesting in the way they show the relative value of different coverings. One table works out their cost on a basis of first cost, and five years' interest plus the cost of the coal represented by the heat units lost. The superior qualities come out at the least total cost, the hair-felt asbestos sponge varieties being the best.

In this record of tests there was no account taken of the plastic varieties of covering, a fact regretted by one speaker in the discussion, who pointed out that from 20 to 35 per cent. of the whole area to be covered must be dealt with by means of plastic coverings, and, therefore, these had a distinct commercial importance.

Another speaker pointed out that he also had made tests at different pressures, and had arrived at almost the same comparative results, whence may be inferred that the tests fairly represent facts, and that the loss of heat with the best types of cover may be calculated at half a thermal unit per ft. area per hour per degree of temperature difference, while for second-rate coverings the loss runs up to three-fourths of a unit, or, perhaps, to 1 unit at high pressure. As already stated, bare pipes cost from 5s. to 6s. per ft. There is undoubtedly much heat lost for lack of efficient covering. The front end plates of Lancashire boilers are often left bare for appearance sake, because the coverings are so badly put on, and become untidy. Lancashire boiler ends should be covered by material cased in Russian iron and clipped to the angle iron ring, so as to be easily removable.

It should be possible to cover the whole end of a Lancashire boiler with four or five such cased pads hooked neatly together. Valve bodies also need covering. While a boiler end may be costing £6 or £8 a year, a valve will be wasting heat at the rate of 20s. to 40s., and the bare cover of the manhole mouthpiece is costing nearly a sovereign per annum.

Some engineers enclose the whole upper part of a boiler below a floor, which is itself well protected. This system provides for bare mounting blocks, so long as the imprisoned air really is imprisoned and unable to get away. Probably the best method of covering a manhole mouthpiece is to use a sheet steel cover lined with the non-conducting composition, fitting down close on the boiler crown cover and easily removable. The necessity for

covering flanges need hardly be referred to. In a 6-in. pipe a bare flange offers about 2 sq. ft. of exposed surface, and costs from 10s. to 12s. per year more than if covered. The flange may not be in contact with steam, but it becomes nearly as hot, and metal transmits heat fast, so that the flanges are kept hot by conduction from the body of the pipe.

From the numerous tests that have now been made upon steam-pipe coverings, and the uniformity with which they have shown that it is to imprisoned air that they all owe their value, it may be laid down that all such coverings should consist of a structure of small air cells in which a portion of air is imprisoned. Hair and sponge are such cellular-forming materials, but appear to require compounding with non-combustible asbestos, both for ease of application, as well as for durability and neatness.

CONCILIATION IN TRADE DISPUTES.

It is frequently asserted that England is far behind other countries in the matter of domestic legislation; that Parliament shows no alacrity to advance with the times; and that, being thus handicapped, the country which used to take the lead is now being left in the rear of commercial enterprise. For our part, we often have occasion to rejoice at the refusal of ministers to adopt any measure which is based upon some new principle until they have had an opportunity of studying the effect of similar legislation in other countries. Just as we, in England, have profited enormously by the experiments of other nations in electrical traction and other commercial applications of electricity, so we hope to reap similar advantages from the failure or success of other experiments abroad.

In this connection it is instructive to refer to the progress of that advanced form of legislation where a deliberate attempt is made to exercise State control over the labour market. Fortunately, as we think, the mother of Parliaments has, up the present, resisted all temptations to encroach upon this dangerous ground; but it seems that the legislative assembly in one of the Colonies has not shown the same reluctance. Impelled, as we suppose, to this course by the voice of popular clamour, the New Zealand Parliament in the year 1900 passed an Act which had for its object the compulsory reference of every dispute between capital and labour to a national Court of Arbitration. A study of some of the more prominent features of this measure and the history of its working in actual practice cannot fail to be of the greatest interest and assistance to those who, in this country, are still working on the old lines, but are desirous of introducing some greater measure of State interference in labour disputes.

The New Zealand Act of 1900, as amended by the Act of 1901, provides that any party to an industrial dispute may refer the same for settlement to a Board of Conciliation. Boards of Conciliation have been established for different districts throughout the country. Other parties may appeal and be heard upon the reference. In every case where an industrial dispute is referred to a Board for settlement, the following provisions apply: (1) The Board, "in such manner as it thinks fit," shall carefully and expeditiously inquire into the dispute and all matters affecting the merits and the right settlement thereof. (2) For the purposes of such inquiry they may summon witnesses, &c., and receive evidence. At the conclusion of the hearing they may make such recommendation with regard to the settlement of the dispute as they think proper. In case the settlement suggested by the Board does not commend itself to the parties, an appeal lies to the Court of Arbitration, which consists of three members, one of whom is appointed on the recommendation of the industrial unions of employers, one on the recommendation of the industrial unions of workers, while the third member, who also acts as president, is Judge of the Supreme Court. The parties to the proceedings before this Court are to be the same as the parties to the proceedings before the Board of Conciliation. The Court has "full and exclusive jurisdiction to determine all matters before it in such manner in all respects as in equity and good conscience it thinks fit." It may accept, admit and call for such evidence as in equity and good conscience it thinks fit, whether strictly legal evidence or not. The decision of a majority of the members present at the sitting of the Court, or, if the members present are equally divided in opinion, then the decision of the President is to be the decision of the Court. Any award may extend to and bind as subsequent party thereto every industrial union, industrial association or employer who, not being an original party thereto, is at any time whilst the award is in force connected with or engaged in the industry to which the award applies within the industrial district to which the award relates. The Court in its award, or by an order made upon the application of any of the parties at any time whilst the award is in force, may fix and determine what shall constitute a breach of the award, and what sum not exceeding £500 shall be the maximum penalty payable by any party in respect of any such breach. By an Act which was passed in 1901 the powers of the Court under this section were so extended as to enable them, on the application of any employer, industrial union, or industrial association in any industrial district where the award has effect, to any person, employer, industrial union, or industrial association within such industrial district, to prescribe a minimum rate of wages or other remuneration, with special provision for a lower rate being fixed in the case of any worker who is unable to earn the prescribed minimum. If any party on whom the award is binding commits any breach thereof by act or default, then a party to the award, or the Registrar, may apply to the Court for the enforcement thereof. On the hearing of such an application the Court may either dismiss the same, or impose such penalty for the breach of the award as it thinks just in either case, with or without costs. All property belonging to the judgment debtor (*i.e.*, the person who declines to obey the award) is available in or towards satisfaction of the judgment debt; and if the judgment debtor is an industrial union or an industrial association, and its property is insufficient to fully satisfy the judgment debt, its members are to be held liable for the deficiency.

The first reflection forced upon the mind after a perusal of this measure is, How is it to be enforced? The Court may order a workman to accept a particular wage, and it may direct an employer to pay an irreducible minimum to each particular class of artisan. But how is it possible to compel one man to work or another to employ him? If placed with his back to the wall the employer can always reduce the number of his employés, or he can cease to manufacture. The workman, again, can also adopt a purely negative attitude; and the result in either case must be disastrous to the community. Several instances were given by a correspondent to the *Times* (May 5th), which show that the evil results of this kind of legislation cannot be overstated. Thus he writes:—

> In one industry a firm found that since the award was made, they had had to dispense with six hands who were unable to earn the *minimum* wage of the £2 8s. per week. Before the award the men received 35s. to 36s. a week, which the employers considered sufficient for the class of work performed. The employers were willing to retain four or five of these hands provided they obtained a permit to work for a lower wage than that prescribed by the Court. The secretary of the union was applied to, but he refused to grant permits to enable the men to work at the wages named. . . .
>
> In another industry it was found that the wages of boys as fixed by an award resulted in loss to the employer. The minimum wage for a lad up to 16 years of age, was fixed at 10s. per week, with an increase of 5s. per week for each year above that age. The trade being a skilled one the employers considered that 10s. a week was too much to pay a beginner, who during his first year was really not worth more than 5s. or 6s. a week. One firm in this industry had in their employ a very small lad, who had been with them nine months, and was getting 6s. a week. When this award was made, owing to his age his wage had to be increased to a £1 a week. The firm could not continue to pay him the increase, and after a few weeks he was discharged.

It is difficult to see how the New Zealand legislature, having placed this measure upon their statute book, can so amend the law as to be in a position to deal with a deadlock of this kind, As a result of their intervention, men have been thrown out of employment. Even more serious is the stagnation which threatens to affect, even if it does not altogether extinguish, certain industries.

The cabinet-makers' lock-out at Auckland was occasioned by a determination on the part of employers not to give effect to an award which had been made against them. It appears that the Court of Arbitration made an order fixing the wages at a certain rate. As this rate was utterly above what they could afford to pay, the employers stood together, and refused to employ more than a certain number of men. It seems that an attempt is now being

made to compel the employers to recognise the award, but in spite of the wide powers conferred by the Act, it is inconceivable that any order could be drawn up so as to compel an employer to keep any particular man in his employ.

The failure of the New Zealand Conciliation Act, as evidenced by the facts above set out, awakens no surprise in our minds. There is nothing more futile than interference by grandmotherly legislation with the empirical laws of supply and demand. The statistics to which we have alluded seem to leave out of account the needs of the public in whose interest both employers and employed are constantly striving. To lay down any hard and fast rule to the effect that the wages to be given to a particular workman when engaged at a specified employment shall not be less than a certain amount is easy enough; but does the tribunal who fixes the amount make proper allowance for any rise which may take place in the price of raw materials; for increasing or diminishing population; for the prospects of the market where the article in question is bought or sold? What are the broad results of this legislation, which, upon the whole, seems to have been interpreted favourably to the workmen and adversely to the employers. Wages have gone up all round, and as a natural result the cost of living has also increased. Employers have been driven, in spite of threats on the part of those who seek to enforce the spirit as well as the letter of the awards of arbitrators, to diminish the number of hands employed. More serious still, the cost of production is increased to such an extent that capitalists find it more economical to import large quantities of ready-made articles from other countries, and this in spite of the fact that heavy import duties have to be paid to the coffers of the State. These and many other disastrous consequences are only to be expected when the State endeavours to intervene to modify the relations of capital and labour. It is also a significant fact that the awards of the Court of Arbitration have hitherto been for the most part in favour of the men; and the encouragement thus given to labour to seek the intervention of the State may result in renewed calls upon the good offices of the Court of Arbitration. We trust that, profiting by the experience of one of our colonies, the British Government may refrain from any attempt to introduce legislation of this kind.

THE INSULATION AND MECHANICAL PROTECTION OF ELECTRIC WIRING.

By A. H. M.

Although an immense amount of matter has been written in relation to the above question, the problem is of such extreme importance, and the present condition of affairs so undecided—in fact, it may be said, so unsatisfactory—as far as the adoption of a standard system is concerned, that the writer thinks a few remarks, which are the result of practical experience of various systems, may not prove unwelcome.

The chief difficulty appears to be in combining the strong points existing in each different system into one, and as, so far, this has apparently not been satisfactorily accomplished, the writer proposes to enumerate some of the features of those most in vogue, which may, perhaps, prove of assistance in determining which is the most suitable arrangement for given requirements.

Wood Casing.—For indoor work there are places where wood casing may be used with most satisfactory results. For instance, it is very suitable for running under wood flooring, and it is an excellent plan to lay a channel-shaped length of 18 G galvanised iron along each run, it merely being necessary to drop the channel piece over the casing after the capping is screwed on; it will then retain its position without any fixing. The advantages of this arrangement are—(1) Moisture, which might otherwise percolate through the gaps in the floor above, and reach the wiring, is diverted, and rendered harmless; (2) the system is to a large extent rendered rat-proof; (3) the wiring is protected against nails driven through the floor, it being practically impossible to pierce a piece of 18 G iron with a nail, the iron being at the time fixed upon a support of such a yielding nature as wood casing.

If the grooves and dividing fillet of the casing are thoroughly brushed with a hard-drying and insulating varnish, wire of a comparatively cheap and lightly insulated character may be used with perfect safety. The extra cost involved by the adoption of this device is very moderate, as wood casing of the cheapest class answers every requirement, and provided that the casing is treated with varnish as suggested above, low-priced wire, certainly not over 300-megohm grade, will prove perfectly satisfactory.

In ordinary house wiring a considerable portion of the work has to be carried under the various floors, and the scope for the adoption of the above system is therefore very considerable.

With certain modifications a similar arrangement may be adopted with success for out-of-door work; for instance, suppose it is necessary to run wiring in a horizontal direction along the outside of a factory or similar building. Under such circumstances the casing should first receive two coats of good waterproof paint inside and out. It should then be supported and fixed 2 in. from the wall, with the grooves upwards, and resting upon projecting pieces of creosoted hard wood driven into suitable cavities in the masonry. The wiring, or cable, which should be of 600-megohm grade, must then be laid in position, the cover screwed closely on, and the channel sheet-iron of 20 G dropped over. In this instance the sides of the channel must be deep enough to hang down 3 in. lower than the bottom of the casing, and it is a point of the highest importance that the junctions of the various lengths of channeling shall overlap each other about ½ in., *and be carefully soldered.* It may be added that a screw here and there will be required to prevent the channeling from being disturbed during high winds, and that plain, cheap insulators may be interposed between the casing and the projecting supports with advantage.

Work carried out in the above manner may be relied upon not to give the slightest trouble for a great number of years.

Plain Iron Gas Barrel.—The advantages here are:—(1) Great mechanical strength; (2) moderate cost; (3) small space occupied. There are, however, several serious drawbacks, the chief being the constant trouble caused by moisture condensing upon the inside of the pipes and forming a mixture of iron rust and water, which quickly breaks down the insulation of the wiring. Then, again, there are frequently rough and sharp projections in the interior, which prove disastrous to the wire coverings during drawing in.

By the adoption, however, of certain precautions the efficiency of this system may be immensely increased. The procedure recommended is as follows:—

A suitable tool must be passed completely through each length of pipe in order to ensure that all projections are levelled. This should preferably consist of a circular plug of hard steel, slightly smaller than the bore of the pipe, and file-cut on the circumferential surface, which will rub down any projections in the interior. This should be attached to a rod of iron long enough to allow of the tool being passed backwards and forwards through the pipe several times.

If the length of piping is held in a vice during this operation, it may be easily done in a thorough manner with merely a trifling outlay of time to each length.

Then follows a treatment with paraffin-wax, which is some little trouble, but which amply repays the time expended by the ease with which the wires may be drawn in, and by the preservation of the wiring on account of the prevention of condensed moisture in the pipes. Suppose we are about to deal with a 12-ft. length of barrel. This must be supported in a slightly inclined position, with one end about 2 ft. lower than the other, the lower end being stopped by means of a cork or plug. Immediately below is fixed another length of piping, perforated at intervals and arranged to form a bunsen gas burner, the jets playing upon the pipe under treatment at intervals of 2 ft.

In a few minutes the pipe will be thoroughly heated along its entire length. As soon as the requisite temperature is attained (which is easily decided upon with a little practice) the pipe is filled with molten paraffin-wax by means of a heated vessel having a thin spout (which must be kept very hot). After a minute has elapsed, the plug is removed from the lower end,

and the surplus wax allowed to run off into the heated vessel for further use. The pipe is now removed, and when cold will be found to have received a closely adhering coat of wax, which nothing short of scraping with a hard tool will remove.

This treatment will be found to effectually do away with the bugbear of iron pipe work, namely, breaking down of insulation by condensed rusty moisture.

The pipe itself is, of course, also protected from damage by interior rusting.

Iron gas piping is largely used for stems in all kinds of outside electric light fittings—shop window lighting, for instance—and the writer has found that when the interior is waxed in the manner described, that instead of proving the weakest and most troublesome point in the system, that no breakdown whatever has occurred after many years' service.

Lead-Sheathed Conductors.—This system has the advantages of neatness and easy manipulation, but some mechanical protection beyond the lead is required in the majority of situations. If the wires are buried in the wall-plaster, protection from nails subsequently driven in, becomes necessary. This may be effected by fixing the wires, about 1 in. apart, by means of clips, and over them a strip of wood about $\frac{1}{8}$ in. thick (the cover supplied with wood casing will do well).

On the top of the thin wood strip must be tacked a strip of 16G galvanised sheet-iron, wide enough to cover the wires and overhang about $\frac{1}{2}$ in. on each side, whilst the junctions of each length must slightly overlap.

For out-of-door and exposed situations where the conductors are liable to meet with mechanical injury, the writer has known excellent results to be obtained by the use of lead-sheathed cables run in creosoted hard wood casing, as a mechanical protection.

For interior surface wiring where the conductors are out of the way of mechanical injury, the "twin" lead-sheathed system is very suitable, and is extremely neat in appearance, and easy to fix, besides possessing the advantage of being easily adapted to bends, cornices, &c.

There appears to be an impression amongst some contractors that lead-sheathed cables are an expensive luxury, but an inspection of the leading price lists will show that the increase in cost over ordinary insulated wires is only about 15 per cent. on the average—not such a very large item, considering the adaptability and special advantages attached to this class of conductor.

An instance occurs to the writer where lead-covered conductors simply cleated to a wall with no further protection, have been in use for 10 years, exposed to all weathers, but out of the way of mechanical injury, and are still in sound condition.

Enamelled Steel Tube Systems.—These may be divided into two great classes, the cheaper class consisting of close joint tubing, with sliding socket joints, and the more expensive class in which the tubing is brazed at the joint, and screw coupling is employed.

As far as ease and quickness in running the wiring is concerned, the writer considers the cheaper of the two systems to be the best, as the various lengths of tubing may be slipped into position, without any of the objectionable twisting round with the wires inside, which is so frequently resorted to where screwed joints are employed.

The objections to the sliding socket joint are that they are not moisture proof, and that the fit is so poor, that the metallic continuity of the system is not assured, and as a consequence the efficient earthing of the whole of the tubing—a point of the highest importance—is difficult to attain.

In order to overcome both of these troubles, the writer has seen the following procedure resorted to with considerable success.

The end of the tube which enters the socket, and also the interior surface of the socket itself, are scraped or rasped fairly bright, a strip of very thin sheet lead is then formed into a sleeve or liner and placed inside the socket. The tube is then forced home into the lead-lined socket and the joint painted. The result is a moisture proof and electrically-continuous joint.

Provided that the complete system of tubing can be installed, and the wiring afterwards drawn in, the screwed joint work is, no doubt, the best, but even here it is necessary to see that both the screwed ends and the sockets are fairly clean and bright before putting together, as otherwise in case of a leakage of current, considerable difference of potential may exist at different points in the system, and injury to individuals may result.

The writer thinks a very satisfactory arrangement would be to enclose a thin bitumen tube within a cheap class of enamelled iron close-joint tube. The bitumen tube would be perfectly damp-proof, prevent condensation, and give a very high insulation, thus allowing of a cheaply insulated conductor being used, whilst the outer tube would be nail and rat proof, and would, in short, provide all the mechanical protection required in the vast majority of positions.

Bitumen tubing has, of course, been obtainable for many years past, but it is altogether too weak mechanically to use without some further protection.

The whole subject of a cheap and durable system for the protection of insulated wires is of immense importance to the electrical industry, and the writer trusts that a few suggestions of value may be found amongst the foregoing.

THE ABOLITION OF THUNDERSTORMS.

***** The interviewer who puts his valuable services at the disposal of some of our respected lay contemporaries has apparently made a mistake in addressing his envelopes, and we publish the following article with all reserve:—**

Having heard wonderful reports about the change which is expected shortly to come over the English climate owing to the spread of electric traction, I recently called upon Prof. Von Humboug to learn the truth of the matter. Entering his splendidly-equipped laboratory, I found the learned gentleman seated in a revolving booster and combing his hair with a copper brush. He was wearing a neat pair of spectacles having gutta-percha lenses and an ion frame; and was warming his feet at a large lump of radium lying in the fireplace, the heat rays of which were visibly dancing in the ether. Plunging at once into the middle of the subject, I asked him,

"What is this I hear, Professor, about the abolition of thunderstorms? Is it true that we shall never have any more?"

"Certainly it is true," he replied, "they would be unknown to the present generation of Englishmen if it were not for the dilatory tactics of the House of Commons, and for the vested interests of the Incorporated Society of Lightning Conductors."

Lost in amazement, I could only gasp my request for further information.

"It is like this," the Professor continued, toying elegantly with a thunderbolt which at that moment crashed through the ceiling, "electricity is a fluid, or more correctly speaking, a liquid, which, in the olden days, was made by distilling amber——"

"Is that why the Romans called amber 'electrum?'" I interrupted.

"Of course," he said, "every Board School teacher knows that. The process, however, did not work smoothly because of the flies in that mineral, which constantly caused the retorts to lift; and, besides, most of the material won was wanted by Drs. Salmon & Gluckstein for their researches upon the laws which govern the motion of smoke in pipes. The next advance was made by Benjamin Washington, who never told the truth. He succeeded in collecting several large microcosms of electricity from the atmosphere by holding up an enormous condenser attached to an india-rubber tube; but his experiment failed of complete success through his ignorance of that curious property of electricity which I will explain immediately. Numerous people, however, thought Volta wrong in his idea of seeking electricity from the clouds; believing that it really existed in water. They, therefore, erected huge weirs in rivers, sometimes called turbines, which extracted the precious metal as the water flowed through. Occasionally, I understand, an inferior quality of electricity has been made in this manner, but it is generally so contaminated with foreign matter as to need purification in a static or revolving transformer—apparatus

you will know better by their common names of filter-press and centrifugal machine—before it is fit for making up into lamp oil or abdominal belts. Natural water, you know, is nearly always hard, and so it has been difficult to get what little electricity that liquid contains out of it. Other investigators attempted to manufacture electricity from coal; and this method proved moderately satisfactory until Sir William Richmond managed to pass Ohm's law for the suppression of smoke through the British Legislature.

"While this work was going on, Prof. Dewar liquefied the air, and the company which now supplies Londoners with liquid oxygen as a summer drink was promoted. You remember the outcry last winter about their twopenny tube leading from the works to the city, becoming choked with bacilli; but, perhaps, you are not aware that when the deposit was examined in the stethoscope it was found to consist of solid matter condensed from the air, including small quantities of cæsium, euphonium, plasmium and other by-products of combustion, together with large masses of electron."

"I thought," said I, "an electron was the same thing as an iron?"

"Oh, no!" he returned, "nobody knows what iron is, although some persons allege that it can be ionised—I have never seen any in the pure state. An electron is believed by Von Wimshurst (whose name I mentioned before) to be a piece broken off an atom, which is a particle incapable of further sub-division; but my experiments demonstrate it to be composed of hypothesis."

"Well, as I was saying," the Professor continued, "the electron from the tube was synthesised by order of the L.C.C., when Cardinal Pole observed that it flows along pipes like other liquids; but it has the astonishing property of running on the outside. Coal gas and water usually run inside a tube, but electricity runs outside; so conductors are now made hollow with their walls inside the bore. Had Faraday, as I hinted just now, been aware of this, and had he turned his rubber tube inside out, there is no doubt he would have succeeded in collecting sufficient electricity from his kite to break the Standard Oil Co. As the representative of a daily paper, you have, of course, a thorough knowledge of all branches of science," (I blushed acquiescence) "and you will see what I am coming to. Since the only source of electricity is the air, when more of that liquid is used for lighting, warming and driving vehicles, there will be less left for the manufacture of aerial pyrotechnic displays; and by the time the steam engine is swept off the face of the earth, the weekly flashes of lightning will cease to exist. I need not remind you of the doctrine of the conversation of energy. Sir William Crookes has shown that there is a limit to the production of oxygen, and the same thing applies to electricity. The quantity present in air is very small; I make it 0·0000053489 per cent. by volume at atmospheric pressure and at the absolute zero of the electric furnace."

"Wonderful indeed!" I ejaculated. "May I ask two questions?"

"Certainly."

"Do you wear gutta-percha glasses to prevent you seeing both sides of a question? And how did you make this discovery?"

"No," Professor Von Humboug modestly replied, "only lawyers are guilty of looking at two sides of a question. The scientific expert only sees one, and not always the whole of that. I wear electrolytic spectacles to prevent my making too many discoveries out of the silly season when the papers are to busy to record them; you notice the glasses have been given an hyperbolical figure. The germ of my discovery (like so many other micro-organisms) came to me while dozing in one of Mr. Passmore Carnegie's free libraries over a rare and comparatively unheard of book called the 'Encyclopædia Temporensis.' Allow me to hand you a competition."

I fled.

Birkenhead.—The Electricity Committee of the T.C. has recommended that from July 1st ordinary consumers of electricity for lighting purposes shall have the option of a fixed rate of 5d. per unit, instead of the maximum demand scale.

THE PREVENTION OF ELECTRICALLY-DEPOSITED DUST.*

By DONALD SMEATON MUNRO, A.I.E.E.

It is a fact which has been noticed with annoyance by most persons who have had to do with lighting installations, that when current is supplied "continuous," and when one wire is earthed, and where the voltage is above 200, then dust gathers in quantity in the vicinity of all flexible conductors. The phenomenon is marked also at one of the poles of the main switch, and on the distribution boards.

The lamps, too, on such circuits, have their comparatively short period of efficient life shortened by the accumulation of a film of sticky dust on the outside surface of the bulbs.

Taking an ordinary city installation fed by three cables, of which the centre one is earthed, it will be observed that the marble or slate slabs on which the positive and negative poles respectively of the main switch are mounted are uniformly dusty, while the slabs on which the earth-connected brasswork is mounted remain clean. If a circuit be traced, the dust marks are not often objectionable until the flexible conductors are reached, but most private houses and offices have a considerable number of yards of "flexible" in use. When it is led across a wall or ceiling in such an installation, the surface soon becomes strongly marked with a broad black line, which is unsightly and permanent. The silk braiding also gathers an amount of dust which, in ordinary circumstances, would be out of all proportion to its collecting area.

It seems evident, then, that a number of the small particles of suspended matter, in a normal room, are floating in the air approximately at earth potential. They are drawn towards the outer wire, be it positive or negative, and those particles which are not too firmly caught and held in the small hairs of the braiding, are in time charged and projected with force against, as well as attracted by, the wall, or whatever happens to be near.

With the object of comparing differently surrounded conductors, I prepared a board with a surface of smooth white paper; vertically across this were fixed a number of conductors all of the same resistance. The wires were separated from each other by a 2-in. space, and the distance from the surface of the paper to the nearer side was, in all cases, ·5 in.

Half of the number were connected to the positive side of a distributing board, and the remaining wires were connected to the earthed side. The sectional area of each was ·0019 sq. in. They were connected in parallel and fed a number of glow lamps. During the period of operation the current in each wire was ·25 ampere. The difference of potential was 250 volts.

The period of trial extended over one month, and the circuit was closed for 120 hours, being four hours nightly. The switch was placed on the lamp side of the test wires, so that they might always remain charged while the lamps were off. The wires under observation included bare copper; vulcanised-rubber silk-covered flexible; Glover's class 55 V.I.R. taped and braided; and a V.I.R. copper conductor covered concentrically with lead.

After eight days the positive bare conductor, and the external positive concentric, were distinctly covered with dust, and the paper behind them held a streak of dust composed of particles which had attached themselves, all with their greater axes at right angles to the plane of the paper. The silk-covered flexible next showed signs, and in about 14 days was thickly covered, and had strongly marked the paper. At the end of the test the Glover wire, and the paper behind, showed slight signs.

In the case of the wires connected to the earth side, similar specimens were used, but there was not the slightest evidence to hint at their being dust collectors.

These results are just what might have been expected. The experiment was rudely practical, but offers suggestions which could be utilised with advantage in similar installations.

In ordinary circuit wiring, the comparatively thick dielectric on the taped and cased conductors minimises the collecting property, and the nuisance is kept within bounds. I do not see how it is possible to prevent the dust collecting

* See also Elec. Rev., Vol. 46, pp. 840 and 876.—Eds.

in quantity on high-voltage lamps, unless the bulbs are washed fairly often.

But standard twisted flexible wire is the most troublesome, and, as the test proved, the trouble would vanish if the flexible were made concentric, and with the earth-connected wire outside. The outside conductor would, of course, have to be insulated to come within the rules of the majority of supply companies.

If such wires were adopted it would do much to delay the ruin of many a valuable wall decoration, be it paint, paper, or tapestry.

ELECTRICITY SUPPLY IN LONDON.

The Local Government and Statistical Department of the London County Council has published an interesting analysis of the accounts of all the undertakings supplying electricity within the County of London. The information is brought down to the dates of the latest accounts issued by the undertakers, including both local authorities and companies.

The suppliers are equally divided between municipal traders and private enterprise, viz., 15 of each class, and the statistics show that, so far from any monopoly of supply on the part of companies being recognised, there are three of the Metropolitan Boroughs in which the local authority competes with a company, ten boroughs in which two companies supply, and two others, where three companies are in competition, whereas monopolies exist in the case of 12 boroughs where the supply is in the hands of the municipal authorities.

The memorandum points out that "The policy of the Board of Trade has been not to allow companies to obtain provisional orders which would enable them to compete with local authorities previously authorised to supply electricity."

It is clear, therefore, that the cry of "monopolist," as applied to the private companies, is absolutely unjustifiable, for although, in some cases, the pioneer companies have not been subjected to competition, there is nothing to prevent it, so far as legislative enactments are concerned, and, as stated, the policy of the Board of Trade appears to have been to establish monopolies in the hands of local authorities, while allowing competition among companies.

In any case, so far as the London companies are interested, even if not interfered with, their monopoly is strictly limited to what in a new industry can only be deemed the pioneering period, because at the expiration of 42 years from *August 26th, 1889*, the local authorities have the right to take over the undertakings upon the terms of Sec. 2 of the Electric Lighting Act of 1888.

The limitation of the tenure by dating it from August 26th, 1889, is directly opposed to the intention of Parliament in extending the term from 21 years under the Act of 1882 to 42 years under the Act of 1888, such period to be reckoned from the date of the passing of the Act confirming the provisional order.

It is true that the clause provides also for "such shorter period as is specified in the provisional order," but in agreeing to reduce the term some *quid pro quo* would be expected to be given.

It was generally admitted that a less period than 42 years was inadequate to obtain a fair return upon the capital expenditure, and yet in the case of the last London order granted to a private company (Lewisham Electric Lighting Order, 1901), the 42 years is dated from August 26th, 1889, and the term really reduced to 30 years.

The object of the clause was probably to enable the London County Council to purchase all the London undertakings at the same time, on the most unfavourable terms to the companies, but bad as are the terms of Sec. 2, even after a full 42 years' tenure, they become infinitely worse if the period be shortened under the existing practice.

"The main object kept in view," says the statistical officer, "in the preparation of this return, has been to present the various statistics and the analysis of accounts, in such a form that the undertakings of the various local authorities and companies might be readily compared."

We suggest that another, and very palpable object, was to bolster up the case in favour of municipal trading, by presenting a series of figures intended to show that under municipal management the business was better conducted in the general public interest than by the companies.

The Joint Committee has been reappointed to continue the investigation into municipal trading, and the London County Council thus publishes its case so far as electricity supply undertakings are in question.

One of the difficulties experienced in preparing such a return necessarily consists in what we have repeatedly pointed out, viz., the want of uniformity in the systems of keeping the accounts and in the audits.

The forms of accounts prescribed by the Board of Trade differ in the respective cases of local authorities and private companies, especially in the provision for depreciation, which is only demanded in the case of companies, although recognised by a few of the local authorities.

In the case of Fulham, by the way, an item of £3,205 is specified in the *depreciation* fund, which was really an amount received from contractors as penalties for delay in completion of works. How this can deemed a depreciation fund is a mystery of municipal finance.

We would suggest that such an amount should have been taken off the cost of the works—less any sum for interest paid on the loan during the period of delay—but the analyst does not find fault with the mode of dealing with it, although careful with reference to some of the company's accounts, even to correcting the Board of Trade in the matter of income-tax, which they complain of as "being charged to the revenue account under the heading of rates and taxes." Just the place where we should have expected to find it!

The statement is made that "In analysing the accounts of these companies the necessary adjustments have been made," and it will be well, therefore, to take these returns with a large grain of salt.

A table is published showing the working of the London undertakings, and set out in the order of the lowest price obtained for private supply, and it is pointed out that prices are generally lower in the case of local authorities than in that of companies.

Before accepting these figures, a few general principles must be considered.

The question is not merely one of price charged, but also whether the charge is commercially sound.

Take the first name on the list, *Stepney—facile princeps* of cheap suppliers—only obtaining in its second year of trading 2·73d. for private supply, and 1·62d. for public lighting, and compare this with *Islington*, in its sixth year getting 5·16d. for private and 2·98d. for public lighting.

How is this enormous difference accounted for? In the case of Islington the public lighting is 43 per cent. of the total supply, while at Stepney it is only 28 per cent.

The return shows that where the public lighting is undertaken by private companies, the cost is lower than in the majority of cases. Thus the Westminster Co. supply at 1·93d., the Metropolitan Co. at 1·95d.

Before any comparison can be based upon the prices charged, all the conditions of supply must be considered, such as the load factor and the price of coal.

In an industrial centre with a good power load, electric tramways and cheap coal, lower prices are more remunerative than much higher charges in a purely residential district depending upon the lighting demand alone. Hence the fallacy of trying to make out a case for municipal trading by comparing the working of undertakings carried on under essentially different conditions.

(To be continued.)

Inverness Lighting.—At a special meeting of the T.C. on 26th inst., to consider the Electric Lighting Committee's recommendation for the appointment of an electrical engineer to advise the Council in reference to the proposed lighting scheme, a motion to take no further action in the matter was carried by 8 votes to 7. It was stated that the provisional order which the Town Council procured at the initiation of the scheme will lapse at the end of the year. There is a likelihood of a private company stepping in then and taking the matter up. A number of the new premises in the northern capital have been lighted with electricity.

WIRELESS TELEGRAPHY IN THE UNITED STATES.

By E. GUARINI.

(*Continued from page 763.*)

Another arrangement of Fessenden's which we must not omit to mention, has for its object the production of a more

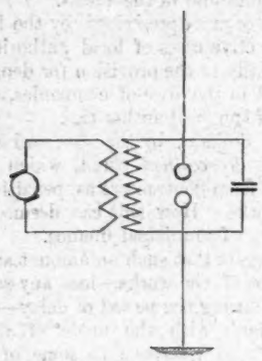


Fig 15

powerful spark, more advantageous as regards radiation, with a given difference of potential. It consists in effecting the discharge in compressed air. This is done without making any essential change in the connections of the transmitter. All that is required is to connect the extremities of the secondary circuit of the induction coil to two pieces of metal insulated from one another and contained in a receiver in which the air has been compressed by means of a pump. The advantage of such an arrangement may be described as follows :—

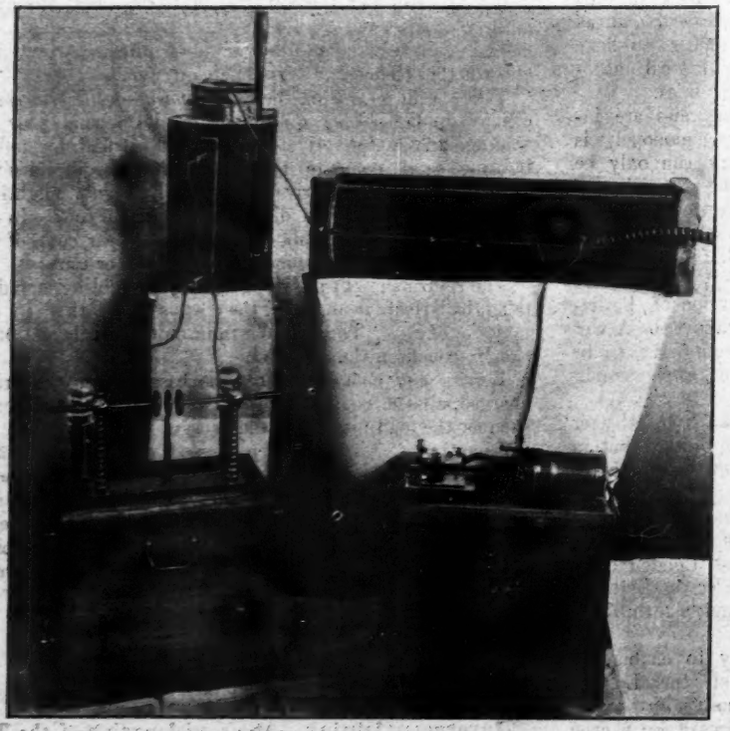


Fig. 16.

In wireless telegraphy we cannot, although it would be advantageous, increase to an unlimited extent the explosive distance, since we should at the same time increase the resistance of the discharging circuit, and the discharge would be changed from an oscillating to a continuous one.

In Fessenden's apparatus, in consequence of the increase of density in the dielectric in which the spark is produced, the balls of the oscillator may be separated considerably beyond the limits prescribed by theory and can, therefore,

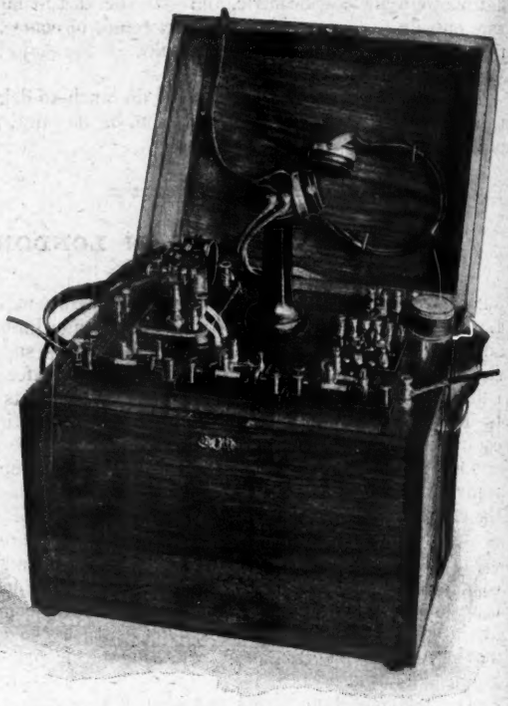


Fig. 17.

produce, without having recourse to an apparatus of larger dimensions, the same effective radiation. Moreover, speaking generally with regard to the Fessenden apparatus, we find certain details worthy of mention :—

1. In order to regulate the sensitiveness of the detector, a battery is placed in opposition with a potentiometer.

2. Warning is given by a carbon auto-decoherer, which rings a bell, for instance. The same auto-decoherer, at the same time, effects a passage to earth for the atmospheric discharges, and in fact, forms, as may be seen by the diagram, a path of less resistance than the others.

3. Two electro-magnets act when the transmitter is influenced (see the writer's Belgian patent, dated May 27th, 1899, for a repeater for wireless telegraphy, and the Electrical Review for November 10th, 1899, p. 749).

The tuning apparatus is not constituted in the usual way, but by wires stretched parallel to one another and to the earth. These wires constitute both the self-induction and the capacity. The capacity and the self-induction are varied in two ways :—

1. By putting, by means of a special key, a more or less considerable number of conductors in circuit.

2. By sliding along two parallel wires little chariots which thus diminish the length of the two wires placed in circuit.

Lastly, in the Fessenden patents and in the articles by Mr. Collins published by various American journals, in particular the *Scientific American* and the *Electrical World*, an apparatus has been discussed which, in the Fessenden terminology, is called a "wave-chute."

It is asserted that the speed of transmission was 30 words per minute and the distance 100 miles.

We now come to a system which, at any rate in the United States, threatens to rival Marconi's. This is Mr. L. de Forest's system, which is worked by a powerful American company.

In the transmitter (figs. 15 and 16) a transformer which raises the pressure of the current to 25,000 volts is fed by an alternating current machine or by a converter transforming continuous current at 110 volts into an alternating current at 500 volts.

The secondary of the transformer charges a condenser which discharges into an oscillator of a special type (fig. 16). The explosive distance is separated into two parts by a metal disc. In the primary of the transformer the circuit is closed by a special key which allows of a great speed in transmission. The oscillator communicates with the earth on the one hand, and with the antenna on the other.

The De Forest receiver (fig. 17) has some interesting features. It may be excited in different ways. In principle it combines the advantages of an anti-coherer, or in other words, a detector, the resistance of which increases under the influence of the waves, and which has no need to be subjected to a shock—with those of a telephone, an apparatus the simplicity of which is its greatest merit.

(To be concluded.)

SOUTH AFRICAN NOTES.

(From our Special Correspondent at Johannesburg.)

May 11th, 1903.

Somerset Strand, C.C.—A meeting of ratepayers is called for May 30th to consider public works schemes, amongst them being the electric tramways proposal mentioned previously, and to decide whether to give the Bill support or otherwise.

Cape Peninsula.—A memorial, signed by the majority of the residents at Mouille Point and Three Anchor Bay, has been presented to the Cape Town Tramway Co., praying for a service of electric motor-cars to those places from Cape Town.

South African Association for the Advancement of Science.—Many interesting papers have been read at the meetings of the above Association, now being held in Cape Town.

Amongst these are:—

"Atmospheric Electricity," by Prof. Beattie and Mr. J. Leyle, M.A., read by Mr. W. H. Logeman, B.A., with recent practical observations taken at Cape Town and Bloemfontein by the reader.

"Some Recent Work on the Discharge of Electricity from Heated Bodies," by Prof. Beattie, read by Prof. Crawford.

Durban, Natal.—Last Thursday was the first anniversary of the opening of the electric tramway system of Durban. On Friday, (May 1st) the town was in total darkness for about an hour, and the tramway service suspended. At places of business, hotels, and other resorts darkness reigned supreme for some time. The cause of the interruption was the failure of the water supply to the boilers, and, of course, fires had to be drawn.

Pietermaritzburg, Natal.—The Finance Committee, at the last meeting of the City Fathers, reported that, with reference to the proposed erection of a new chimney-stack for the electric power station, the following statement had been received from the acting borough engineer:—

"The necessity for a new smoke-stack for the electric power station is evident to anyone who has lately visited the works. We have in hand extensive additions to the existing plant for both electric light and tramways; at present we are erecting two sets of boilers comprising eight furnaces, and another set is on order, which will bring the extra furnaces up to 12. The present smoke-stack was designed to meet the requirements of the old station, having eight furnaces, only half the capacity of the new ones." The engineer then went on to explain the economical and technical reasons for the erection of a new stack, and submitted the various tenders sent in. The one by Messrs. Hamilton & Co., for a mild steel stack lined with 4½ in. fire-brick, to cost £1,439, with a brick foundation to cost £900, a total of £2,339, was accepted.

A requisition by the borough civil and borough electrical engineers for surveying and testing instruments to cost £450, was referred back, to be detailed and specified, so that the local agents would have a chance to tender for the order.

Natal Government Railways.—A new corridor train, built by the Metropolitan Amalgamated Carriage Builders, Birmingham, for the N.G.R., has recently been on view in Johannesburg. It consists of two dining and sleeping cars, one kitchen car, and a guard's van. The train is fitted throughout with electric light on the Stone system, and electric fans are in every compartment.

Bloemfontein, O.R.C.—A Solar motor is to be erected on one of the Government farms near Bloemfontein, and if the experiment proves a success the machines are to be imported in large number for irrigation purposes.

RAILWAY SIGNALLING IN INDIA.

A recent issue of the *Indian and Eastern Engineer* contains an illustrated article on the installation by Messrs. McKenzie and Holland, of Sykes's lock and block signalling apparatus on a few sections of the Bombay, Baroda and Central India Railway at the instance of the general traffic manager of the line, Mr. C. A. R. Crommelin. The apparatus employed seems to be the single-wire system foreshadowed by Lieut.-Colonel Addison's remarks during the discussion on the paper read by Mr. F. T. Hollins at the Institution of Electrical Engineers in 1897. Some four sections from the Colaba terminus have been equipped, and three other cabins were to be completed at Delhi at the other extremity of the line, in time for the anticipated heavy traffic for the Durbar.

The illustrations do not give any constructional details to allow of a comparison with the older three-wire instruments, but show the familiar outward form minus the small semaphore indicator. It is, however, probable that they differ but slightly from the three-wire form, as only small alterations would be necessary to allow of separate bell communication being established over the same wire with the ordinary Sykes instruments. The upper indications, "Locked," "Free," at the sending end of the section, and the lower indications, "Line Clear," "Train Accepted," at the plunging or receiving end, are the complements of each other respectively, and constitute the block indications. Acceptance of a train is given by plunging, after exchange of bell code signals, "Line Clear" being replaced by "Train Accepted" at the plunging station, and "Locked" by "Free" at the other end of the section. The starting signal, of course, can only be lowered at the latter after being unlocked from the plunging station, and when the "Free" indication is being exhibited.

A neat mechanical form of signal replacer, operated by the bending of the rail as the engine passes over it, puts the starting signal to danger behind the train, by throwing slack into the signal wire. The signalman is not able to again operate the signal until after the lever has been replaced in the "On" position, when, of course, it is again locked, and cannot be operated until it has been freed by plunging from the other end of the section. So far as can be seen the signalman at the sending end has no permanent indication of the condition of the line when a train is in the section ahead, since replacement of the signal lever in the "On" position will restore the upper indication to "Locked," which is the normal indication when the section is clear of trains. Sykes's ordinary form of mercury treadle is used for clearing the plunging instrument, after the train has passed out of the section.

The article claims for the lock and block probably all that can be claimed for the system. Of the value of the interdependence established between the electrical signalling apparatus and the mechanical interlocking by such systems there can be no question. As a preventative of following collision, by restricting operation of signals, &c., within a cycle, it is of the greatest possible importance, but it cannot be said that "it also provides for the complete safety of all shunting operations however complicated or intricate a station yard may be." It is the function of the mechanical interlocking to prevent converging collision, and in most cases complicated or intricate yards are worked without block apparatus of any kind, and could not, as a matter of fact, be operated under block rules.

Whilst much stress is laid upon the checks against error which a lock and block system imposes upon the signalman, and the corresponding increase in the safety of operation, nothing is said of the fact that the signalman is not the only person concerned, or the most important; of the difficulty of working traffic under an unvarying cycle of operation, except for the most simple sections; of the use of the ordinary releasing key, and all it implies; the fact that a clearing treadle may under certain conditions be fully operated and lead to a collision; that instruments may be operated by other currents than those intended to do so, and that during fogs or other atmospheric conditions which prevent clear sight of the signals, lock and block systems afford no additional indications to drivers of the actual conditions under which they are running.

Perhaps something might here be said of the tendency which is constantly met nowadays to decry the workman and place his intelligence on a very low level. In this article we find "The train is now master of the section, and however stupid or forgetful a signalman may be, he cannot possibly get a second train on to that section until the first one has passed out of it over the treadle X at A." That a signalman may be forgetful and cause an accident is quite possible, and has occurred many times, but he is not necessarily "stupid." Such accidents occur generally from much the same causes which appear to have contributed to errors apparent in the illustrations accompanying the article under consideration.

ELECTRIC DRIVING OF MACHINE TOOLS.

At the present time, though many machine tools are driven by electric motors, the systems of doing so are crude, and the general appearance is of the same order as that of the earlier motor-cars, very properly called horseless cars, for as in the electric brougham as yet made the absence of the familiar barley motor is very obvious. The modern automobile appears to have better shaken off the trace of the horse.

In driving machine tools, a very ordinary method if the tool is large and heavy, is to stand the motor on the shop floor and drive through a more or less complicated system of belts, thereby retain-

ing many of the faults and inconveniences that accompany belt driving, as well as occupying space on the shop floor, which was otherwise unoccupied. The electric motor screwed down to the floor, and driving by belts, we have seen applied to a heavy planer, which was too heavy a machine to be driven off the shaft which drove the contiguous lighter machines on the group system.

Boring mills are even advertised with the same crude method, the motor standing by the mill, and being more or less in the way of the operator. The group system of driving by means of a shaft of the ordinary type, which is driven itself by an electric motor, is a good and sound system under certain conditions as to the size, number, and constant use of the machines, which are themselves to be of so light an order that they would only require a very small motor if driven each with its own motor. But the great majority of machine tools, if at all heavy, are better if driven by their own motors, and it is quite time that machine tool makers provided their tools with self-contained motors properly and mechanically built into the machine framing.

In ordinary cases where the motor is not fixed upon the floor, it may be found on a bracket bolted to some part of the machine framing. This bracket is only too obviously not an original part of the design. The motor of a machine tool ought, of course, to be so blended with the machine as to be part of it. This is a direction in which the skill of machine-tool designers may very usefully be directed. It is more especially desirable at the present time, since the introduction of the modern tool steels. Many machine tools hitherto properly driven on the group system must now have their own motors. The new steels will take larger cuts, and do much faster work, especially on roughing-out work. They will absorb very much more power, and by doing so they are so much less fitted to be members of a grouped system. They have become more suitable for being independently driven, and they now demand motors of much larger power than were necessary with the older steels and lighter cuts. To attempt to place such motors as though only temporary expedients will be a mistake, and the effect will be bad. Machine tool makers and motor makers should be able conjointly to evolve a design that will be satisfactory in performance and fitting to the eye. It may be, and no doubt will be, a work of more or less tentative experiment to evolve the final type, but it is certain that a type must be evolved, and that machine tools in the near future will be designed with their motors as a homogeneous whole.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

11,196. "Improvements in electric earthing device main, or other circuit cut-outs." A. J. Beaumont. May 18th.

11,242. "Improvements in or relating to the trollies of electrically-propelled vehicles." P. Fielding. May 18th.

11,268. "Improved common battery telephone exchange system with continuous or alternating call current." T. L. Jones. May 18th.

11,276. "Improvements in the manufacture of electrodes." C. Roderbourg. May 18th.

11,290. "Improvements in alternating current motors." L. Schuler and Ferranti, Ltd. May 18th.

11,322. "Improvements in or relating to switches for electric batteries." A. J. Boult. (The Electric Storage Battery Co., United States.) May 18th.

11,347. "An improved tee for conduit wiring." T. Taylor. May 19th.

11,365. "A reserve-holder for sliding-bows on electric street cars and similar carriages." E. Landenberg. May 19th.

11,379. "Improvements in electrical measuring instruments." Evershed and Vignoles, Ltd., and S. Evershed. May 19th.

11,418. "Improvements in regulators for alternating series arc-light systems." H. H. Lake. (General Incandescent Arc Light Co., United States.) May 19th.

11,426. "Improvements in vibrators for sound telegraph apparatus." A. A. Lind. May 19th. (Complete.)

11,427. "Improvements in or relating to radiator systems for wireless telegraphy." A. Blondel. May 19th. (Date applied for under Patents Act, 1901, May 27th, 1902, being date of application in Belgium.) (Complete.)

11,442. "Improvements in and connected with arc light electrodes." O. Vogel. May 19th.

11,509. "Improvements in electrical measuring instruments." Evershed and Vignoles, Ltd., and S. Evershed. May 20th.

11,520. "Improvements in rheostats." H. H. Lake. (General Incandescent Arc Light Co., United States.) May 20th.

11,546. "An improved electrical switch." C. Stirling. May 20th.

11,553. "Improvements in or connected with section insulating bridges for electric overhead conductors." H. B. Harris. May 20th.

11,562. "An improved means for bringing the trolley pulley on electric tramcars automatically." W. H. Cook. May 21st.

11,579. "Improvements relating to anodes for electrolytic operations." F. Greenfield. May 21st.

11,585. "Improvements in overhead trolley or contact arms for electrically-driven tramcars." W. F. Smith. May 21st.

11,587. "Improved method of winding coils and bobbins for electric generators and motors." H. W. Turner. May 21st.

11,591. "Improvements in signalling systems for electric railways." G. Gibbs. May 21st. (Date applied for under Patents Act, 1901, May 22nd, 1902, being date of application in United States.) (Complete.)

11,607. "Improvements in bases for incandescent electric lamps." E. A. Carolan. (The General Electric Co., United States.) May 21st.

11,608. "Improvements in combined lamp sockets and shade holders for electric lamps." E. A. Carolan. (The General Electric Co., United States.) May 21st.

11,609. "Improvements in fuse plugs." E. A. Carolan. (The General Electric Co., United States.) May 21st.

11,624. "Improvements in electric traction." A. Mzorox. May 21st. Complete.)

11,647. "Improvements in electrical transformers and method of making the same." E. A. Carolan. (The General Electric Co., United States.) May 21st.

11,649. "Improvements in lightning arresters." E. A. Carolan. (The General Electric Co., United States.) May 21st.

11,698. "Improvements in self-regulating systems for electric light and power." S. E. Page. (A. S. Adler, United States.) May 22nd. (Complete.)

11,700. "Improvement in electrophone receiver." G. C. Geisler. May 22nd.

11,704. "A new or improved demand indicator for electrical purposes." F. Wyatt. May 22nd.

11,706. "Improvements in electrical switch apparatus." J. W. Jones. May 22nd.

11,713. "An improved circuit breaker." W. H. Campbell and P. C. Hughes. May 22nd.

11,725. "Improvements in electric switches." E. A. Carolan. (The General Electric Co., United States.) May 22nd.

11,726. "Improvements in electrical power factor indicators." E. A. Carolan. (The General Electric Co., United States.) May 22nd.

11,728. "Improvements in electric switches." E. A. Carolan. (The General Electric Co., United States.) May 22nd.

11,729. "Improvements in winding forms for coils for electrical apparatus." E. A. Carolan. (The General Electric Co., United States.) May 22nd.

11,730. "Improvements in systems of electric-motor control." E. A. Carolan. (The General Electric Co., United States.) May 22nd.

11,739. "Improvements relating to coin-freed telephone apparatus." H. H. Lake. (G. Sem, Norway.) May 22nd. (Complete.)

11,736. "Improvements in and relating to telephone switchboards." H. H. Lake. (Elektrisk Bureau, Norway.) May 22nd. (Complete.)

11,761. "Improvements in regulating apparatus for electrical circuits." E. F. Moy and P. H. Bastie. May 23rd. (Complete.)

11,765. "Improvements in fusible electric cut-outs." R. W. Bill. May 23rd.

11,896. "Improvements in and relating to electric driving mechanism for centrifugal machines." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) May 23rd. (Complete.)

11,828. "Improvements relating to electric telegraphy." A. Muirhead. May 23rd.

11,836. "Improvements in electricity meters." H. T. Harrison. May 23rd.

11,846. "Apparatus for transmitting synchronous and equal movements to a distance." Siemens Bros. & Co., Ltd., and A. T. Bartlett. May 23rd. (Complete.)

PUBLISHED SPECIFICATIONS, 1901.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

26,746. "A new or improved process or method of manufacturing electric or other lamp globes." E. Bohm. Dated December 31st.

26,748. "Safety indicating and cut-out apparatus for polyphase electric circuits." Siemens Bros. & Co. (Siemens & Halske Aktiengesellschaft, Berlin.) Dated December 31st.

26,749. "Improvements in electric safety fuses." Siemens Bros. & Co. (Siemens & Halske Aktiengesellschaft, Berlin.) Dated December 31st.

26,754. "Improvements in apparatus for use in charging storage batteries." J. W. Stover and N. H. Suren. Dated December 31st.

26,759. "Improvements in or relating to means for supplying current to electric vehicles." W. L. Wise. (Maschinenfabrik Oerlikon, Switzerland.) Dated December 31st.

1902.

1,355. "Improvements in the construction of underground conduits, more especially intended for use in systems of underground electric traction." T. E. Devonshire. Dated January 17th.

2,034. "Improvements in electric arc lamps." H. Bagget. Dated January 25th.

2,035. "Improvements in electric arc lamps." H. Bagget. Dated January 25th.

4,233. "Method of cutting out large quantities of electrical energy in particular when of high voltage." Siemens Bros. & Co., Ltd. Dated February 24th.

4,634. "Cutting-out contact devices for electric circuits." Siemens Bros. and Co., Ltd. Dated February 24th.

5,263. "A portable electric light for sanitary engineers and others to examine drains, tubes, and pipes with." J. E. Doughty. Dated March 3rd.

5,292. "Improvements in electric igniting devices for miners' and the like lamps." R. Feslindorf. Dated March 3rd.

5,312. "Improvements in instruments for measuring differences of temperature, electrical potential, electrical current, atmospheric dryness, and the like." E. Chauvin and R. Arnoux. Dated March 3rd.

5,323. "Improved apparatus for automatically reversing trolley or other current-conducting poles in overhead and underground electrical tramways and railways." F. E. Ward. Dated March 4th.

5,483. "The combination of electric, magnetic, and carbon microphones." T. J. Howell. Dated March 5th.

5,608. "Improvements in or connected with electric cables or conductors and casings therefor." G. E. Heyl-Dia. Dated March 6th.

5,702. "Improved brake and speed controller for electrically-operated cars." J. A. Thumbling. Dated March 7th.

5,786. "Improvements in reverse electric current relays." British Thomson-Houston Co., Ltd. Dated March 8th.

5,819. "Improvements in electric and other power hoists and cranes." J. Holt, C. Holt and J. W. Powell. Dated March 8th.

6,147. "Improvements in portable hand combination telephones." A. E. P. Werks and A. Brooker. Dated March 13th.

6,066. "Improvements in dynamo-electric machinery." J. H. St. Hill Mawdsley. Dated March 18th.

6,096. "Improvements in or relating to 'switches' for electric motors." R. J. Appleton and J. Oulton.

6,099. "Improvements in or relating to electrical apparatus for signalling." M. Mercier. Dated March 19th.

6,726. "Improvements in and relating to incandescent electric lamps for decorative and other purposes." T. Wohlmuth. Dated March 19th.

6,733. "Improved apparatus for the regulation of electrical circuits in heating devices." W. D. Kelroy. Dated March 19th.

6,818. "Improvements in flexible conducting cords applicable especially for use in the plug circuits of telephone switchboards." G. E. Kingsbury. Dated March 20th.

6,850. "Improvement connected with ceiling roses for electric incandescent lighting." E. Schulz. Dated March 20th.

6,946. "Improvements in covers for the junction boxes of telegraph cables and the like." Callender's Cable and Construction Co., Ltd. Dated March 21st.